Canada. Parliament. House of Commons.
Standing Committee on
Mines, forests and waters
Minutes of proceedings and evidence

1960
no. 1-19

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

---

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 1 - 19



---

THURSDAY, FEBRUARY 25, 1960

TUESDAY, MARCH 22, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESSES:

Honourable Alvin Hamilton, Minister; Mr. T. M. Patterson, Director, Water Resources Branch

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22596-1—1

STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.
*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St-Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Smith (*Calgary South*),*
Stearns,
Woolliams—35.

* Replaced by Mr. Hicks on March 21st.

M. Slack,
*Clerk of the Committee.*

## ORDERS OF REFERENCE

HOUSE OF COMMONS,
TUESDAY, February 16, 1960.

*Resolved*,—That the following Members do compose the Standing Committee on Mines, Forests and Waters:

Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
McQuillian,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Nielsen,
Payne,
Richard (*St-Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Smith (*Calgary South*),
Stearns,
Woolliams—35.

(Quorum 10)

*Ordered*,—That the said Committee be empowered to examine and inquire into all such matters and things as may be referred to it by the House; and to report from time to time its observations and opinions thereon, with power to send for persons, papers and records.

MONDAY, February 29, 1960.

*Ordered*,—That the Standing Committee on Mines, Forests and Waters be empowered to print such papers and evidence as may be ordered by it, and that Standing Order 66 be suspended in relation thereto; and that the said Committee be granted leave to sit while the House is sitting.

WEDNESDAY, March 9, 1960.

*Ordered*,—That items numbered 277 to 281 inclusive, and items 486 and 487, as listed in the Main Estimates 1960-61, relating to the Department of Northern Affairs and National Resources, be withdrawn from the Committee of Supply and referred to the Standing Committee on Mines, Forests and Waters, saving always the powers of the Committee of Supply in relation to the voting of public moneys.

MONDAY, March 21, 1960.

*Ordered*,—That the name of Mr. Hicks be substituted for that of Mr. Smith (*Calgary South*) on the Standing Committee on Mines, Forests and Waters.

*Attest*

L. J. Raymond,
*Clerk of the House*.



22596-1—1½

## REPORT TO THE HOUSE

THURSDAY, February 25, 1960.

The Standing Committee on Mines, Forests and Waters has the honour to present the following as its

## FIRST REPORT

Your Committee recommends:

1. That it be empowered to print such papers and evidence as may be ordered by the Committee, and that Standing Order 66 be suspended in relation thereto.

2. That it be granted leave to sit while the House is sitting.

Respectfully submitted,

H. C. McQuillan,
*Chairman.*

# MINUTES OF PROCEEDINGS

THURSDAY, February 25, 1960.
(1)

The Standing Committee on Mines, Forests and Waters met at 10.30 a.m. this day, for organization purposes.

*Members present:* Messrs. Aiken, Cadieu, Coates, Dumas, Fleming (*Okanagan-Revelstoke*), Godin, Korchinski, MacRae, Martel, McFarlane, McGregor, McQuillan, Mitchell, Muir (*Cape Breton North and Victoria*), Nielsen, Payne, Roberge, Robichaud, Smith (*Calgary South*), and Stearns —(20).

The Clerk attending and having called for nominations, Mr. Coates moved, seconded by Mr. MacRae, that Mr. McQuillan be elected Chairman of the Committee.

There being no further nominations, Mr. McQuillan was declared duly elected as Chairman.

The Chairman thanked the Committee for the honour conferred on him. He then read the Committee's Order of Reference.

On motion of Mr. Cadieu, seconded by Mr. Korchinski,

*Resolved,*—That Mr. Nielsen be Vice-Chairman of the Committee.

On motion of Mr. MacRae, seconded by Mr. Aiken,

*Resolved,*—That a sub-committee on Agenda and Procedure comprised of the Chairman and six other persons designated by him be appointed.

On motion of Mr. Smith (*Calgary South*), seconded by Mr. Korchinski,

*Resolved,*—That the Committee recommended to the House that it be empowered to print such papers and evidence as may be ordered by the Committee, and that Standing Order 66 be suspended in relation thereto.

Moved by Mr. Nielsen, seconded by Mr. Stearns, that leave be asked to sit while the House is sitting.

Carried on Division.

At 11.00 a.m., the Committee adjourned to call of the Chair.

TUESDAY, March 22, 1960.
(2)

The Standing Committee on Mines, Forests and Waters met at 9.30 o'clock a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Baskin, Cadieu, Coates, Doucett, Dumas, Fleming (*Okanagan-Revelstoke*), Granger, Gundlock, Hicks, Kindt, Korchinski, Leduc, Martin (*Timmins*), McFarlane, McQuillan, Mitchell, Muir (*Cape Breton North and Victoria*), Nielsen, Simpson, Slogan, Stearns—(22).

*In attendance:* The Honourable Alvin Hamilton, Minister, R. G. Robertson, Deputy Minister, E A. Côté, Assistant Deputy Minister, and officials of the Water Resources Branch; all of the Department of Northern Affairs and National Resources.

On motion of Mr. Aiken, seconded by Mr. Dumas,

*Resolved,*—That the Committee print, from day to day, 750 copies in English and 250 copies in French of the Committee's Minutes of Proceedings and Evidence.

Copies of "Outline of Possible Examination of Water Problems" were distributed to the members of the Committee.

The Chairman announced the composition of the Sub-committee on Agenda and Procedure comprising the following members: Messrs. Aiken, Coates, Dumas, Martin (*Timmins*), McQuillan, Nielsen, and Robichaud.

The Chairman read the Order of Reference dated March 9 whereby the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources were referred to the Committee.

The Chairman referred to various matters that would be examined by the Committee and further advised that a number of expert witnesses on water resources would appear before the Committee.

Item 277—Administration, Operation and Maintenance,—of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources, was called.

The Minister made a statement describing the various aspects and problems connected with water resources in Canada and was questioned thereon.

Mr. Patterson, Director of the Water Resources Branch, supplied information to questions on erosion.

In reply to questions dealing with the definition of navigable waters, the Minister advised that he would supply the Committee with a report on this matter.

The Chairman advised that it was hoped to have General A. G. L. McNaughton at the next sitting and that a meeting of the Sub-committee on Agenda and Procedure would be held as soon as possible.

Mr. McQuillan advised that the meeting dates allocated for this Committee were Mondays at 11.00 a.m. and Tuesdays at 9.30 a.m.

At 11.00 o'clock a.m., the Committee adjourned until 11.00 o'clock a.m. Monday, March 28, 1960.

M. Slack,
*Clerk of the Committee.*

# EVIDENCE

TUESDAY, March 22, 1960
9:30 a.m.

The CHAIRMAN: We are waiting for the minister at the moment, gentlemen: he is going to make an opening statement. We have a quorum, so we can clear some of the work off the slate here. First I want to welcome you all and tell you how glad I am to see that we have so many familiar faces back with us. I hope we can make an interesting year of our meetings in this committee.

First of all we need a motion to print 750 copies in English and 250 copies in French of our proceedings. Would somebody so move?

Moved by Mr. Aiken and seconded by Mr. Dumas.

Motion agreed to.

The CHAIRMAN: The minister will be with us in a minute: I am just awaiting his arrival before we proceed. In the meantime, we have a tentative outline of the course that we are thinking of pursuing this year, so we will have copies of this program passed around to the members of the committee.

Gentlemen, the minister has arrived. We have already dealt with the first order of business. First I would like to announce the names of your steering committee: Messrs. Dumas, Robichaud, Martin (*Timmins*), Coates, Aiken, Nielsen and myself. I will now read the order of reference for the work of this section.

> Ordered,—That items numbered 277 to 281 inclusive, and items 486 and 487, as listed in the main estimates 1960-61, relating to the Department of Northern Affairs and National Resources, be withdrawn from the committee of supply and referred to the standing committee on mines, forests and waters, saving always the powers of the committee of supply in relation to the voting of public moneys.

From this order of reference it would appear that we are fairly limited in our terms of reference, but I think we will find ample work when we start to go into the estimates of the water resources branch.

At a meeting of the steering committee held shortly after our first organizational meeting it was unanimously agreed that a tentative program, subject to the consent of the house, of an examination of the water resources branch of the Department of Northern Affairs and National Resources, and items 486 and 487—which come under loans and advances—would provide an interesting and, it is hoped, constructive program for the committee this session. An examination of the estimates referred to us for this session will lead us into a rather broad field covering international and interprovincial waters from the Pacific to the Atlantic. It is hoped that we will have a number of expert witnesses appearing before us to give evidence on subjects such as water supply and requirements, conservation and flood control, pollution of waters, hydro electric power, international problems, not at present including the Columbia, because that is under negotiation, but including the Souris river, Great Lakes basin, the St. Croix river, the Passamaquoddy, and a number of other rivers that may come up as we pursue the estimates.

From that very brief outline, I am sure you will appreciate that we have plenty of interesting work ahead of us.

I will now call the first item, item 277, and will ask the minister to give us an opening statement.

**WATER RESOURCES BRANCH**

**Item 277. Water Resources Branch—Administration, operation and maintainance including Canada's share of the expenses of the international executive council, world power conference and authority to make recoverable advances in amounts not exceeding in the aggregate the amount of the share of the Province of Manitoba of the cost of regulating the levels of Lake of the Woods and Lac Seul .......................................................... $ 1,508,354**

Mr. DUMAS: Mr. Chairman, just beore you call on the minister, I notice here that in the sixth item of the agenda we will study, under "International Problems (excluding Columbia)", involving item 279, we have an item of more than $98,000 for the Columbia river. It will be hard to exclude it. Probably you mean the whole problem of the Columbia river.

The CHAIRMAN: We can perhaps discuss it in general, but not in a manner that might conflict with the international negotiations now in progress. Is that satisfactory?

Mr. DUMAS: Yes.

The CHAIRMAN: Mr. Minister, we want to welcome you here, and first I would ask if you would mind introducing to the committee the members of your staff you have present.

Hon. Alvin HAMILTON (*Minister of Northern Affairs and National Resources*): I will ask Mr. Robertson to do that.

The CHAIRMAN: Yes, Mr. Robertson?

Mr. R. G. ROBERTSON (*Deputy Minister, Northern Affairs and National Resources*): Mr. Chairman, the members of the staff here this morning—they would not necessarily all be present at all meetings—are Mr. E. A. Cote, assistant deputy minister; Mr. T. M. Patterson, director, water resources branch; Mr. J. D. McLeod, chief engineer, operations division, water resources branch; Mr. K. Kristjanson, secretary, advisory committee on water use policy; Mr. A. F. C. Sincennes and Mr. M. R. Beauchamp of the water resources branch.

The CHAIRMAN: Thank you very much.

Now, Mr. Minister, would you proceed with your opening remarks?

Mr. HAMILTON (*Qu'Appelle*): Thank you very much, Mr. Chairman.

First of all I would like to say that I welcome this opportunity to introduce to this committee my department's estimates on water resources.

It seems to me that the committee has made a very wise decision to consider water as a resource of Canada in the broadest possible context, before looking at the estimates in detail. By following this order, members of the committee will be enabled to examine the estimates with greater value to themselves, and I hope that they can carry this information out to the public at large, because it is obvious to all of us that these next few years will see some very important decisions made in connection with our waters in Canada.

I have asked officials of my department to make available to the committee several documents which should be of value to the members of this committee in examining this subject.

The first document is a publication of the water resources branch which was prepared on the occasion of the Canadian sectional meeting of the world power conference which was held in Montreal in 1958.

Have the members copies of these, Mr. Chairman?

The CHAIRMAN: They have been passed around, Mr. Minister, or mailed to them.

Mr. HAMILTON (*Qu'Appelle*): The second document is a special article on water which was written for the department's annual report of 1955-56. The third document is Water Power Resources of Canada published on March

15, 1960. That is the blue one here. The fourth is Hydro Electric Progress in Canada 1959, as of January 1, 1960.

With air and soil, water is the third essential to the maintenance of life on our planet. The basic cycle whereby resources of water are replenished on this earth makes of water and air the greatest of renewable natural resources. Precipitation—in the form of rain or snow—is followed by storage of water on or under the soil. Man can then use this surface or ground water, as it is called, for his domestic purposes, to grow food, to grow fish, to transport goods or to multiply his own energy in the form of electricity. As the surface or ground waters run their course they are subject to evaporation and transpiration which lift them to the skies where they are again released as precipitation to repeat the cycle.

Each year, about 8,000 billion tons of water fall on Canada as rain or snow. It is estimated that about two-thirds of this annual precipitation may evaporate or be used by plants. The remainder runs off in streams to constitute what is called surface water or it seeps through the soil or, as we call it, the ground—water table.

Canada's earliest beginnings depended on water. Inland waterways facilitated trade and transportation. They provided food in the form of fish and wildfowl. They also provided early sources of energy. It was in 1606 that one of the first water driven grist-mills in North America was established near Port Royal by Poutrincourt in what is now Nova Scotia.

Without a doubt, the harnessing of our rivers for transportation of the riches in fur and timber, followed by the production of vast amounts of electrical energy for the processing of our vast resources of wood, have been in the foundation on which central Canada's prosperity has been based. Water-borne transportation and hydro-electric power still play a dominant role in Canada's economy.

While Canada is a land almost surrounded by water, I think it would be wise to restrict our consideration on this subject to fresh water supplies.

Canada is blessed with more fresh water than any other nation in the world. About 7 per cent of Canada's surface consists of fresh water. The growing use of water is an essential companion of our progress as a nation. The most commonly used raw material of industry is water. A large papermill uses every day about the same amount of water needed by a city of 50,000 people. 65,000 gallons of water are required to produce one ton of finished steel. Clearly, then, the manner in which Canada's water resources are managed will determine, in a goodly measure, the extent and future of Canada's future progress and the standards of living of its people.

With the exception of certain sections of mid-western Canada, nearly every part of Canada is endowed with surface water and indeed, to some extent, water power resources. For over 65 years these resources of surface water have been inventoried and measured. The inventory of surface water, in cooperation with the provinces, has been intensified and developed fairly rapidly of recent years. Recently, this government decided to intensify the investigations into ground-water resources. It has also begun to examine some of the characteristics of surface water, which affect the flow and use of water, namely sedimentation. There is not yet enough inventorying and sampling being done of Canada's surface and ground-water supplies. This is a long-range matter.

As our population and economy expand, the need for planned development of Canada's water resources becomes evident. It is apparent that the prime responsibility in this field is one which rests with the provinces as far as their territories go. The prime responsibility for the development of water resources of the two northern territories rests with these territories and the federal government. Prior to 1930, Canada administered, among other natural

resources, the water resources of the prairie provinces. Under federal acts passed in 1912 and 1913, Canada passed to the control of British Columbia the administration of all unrecorded waters in the "railway belt" and of the Peace River bloc in British Columbia. By agreements which were explicitly confirmed by amendments to the British North America Act, Canada transferred the interest of the crown "in waters and water powers" within each of these provinces to the provinces.

South of the 60th parallel, the responsibility to develop streams and waters is primarily that of the provinces. They must plan to develop domestic and industrial supplies of water. Irrigation, power, flood control, abatement of pollution, recreational uses of water are the provinces' prime responsibility. The federal government, in turn, has a responsibility to protect and develop inland fisheries, to protect the navigability of streams and, by virtue of its jurisdiction in agriculture, a responsibility to ensure an adequate supply of water for agricultural purposes. In the international field, the federal government has a responsibility to ensure that boundary waters are not polluted to the detriment of health.

Clearly the federal and provincial legislatures have complementary responsibilities as regards the use and quality of Canada's fresh water supplies. Precisely because the need has not become manifest until recently and because of the divided responsibilities, there have not been in Canada the sort of comprehensive basin studies covering the multiple use of water.

I am going to digress for a moment here. These are recent publications in the United States. This one is by John V. Krutilla and Otto Eckstein on "multiple purpose river development—studies in applied economic analysis." That is an example of the type of thing we lack in Canada. This is an American publication.

Another publication prepared by the government of the United States is the report to the inter-agency committee on water resources, and is "proposed practices for economic analysis of river basin projects." That is an example of governmental activity in the United States which we lack in Canada.

These are only two of a number of pieces of literature which could be pointed to as examples of how other countries are moving forward on the examination of rivers as a river basin system.

It is true that we have admirable hydrometric studies prepared by my department's water resources branch. These cover a vast number of rivers and bodies of water of the Yukon, Fraser, Columbia, Mackenzie, Nelson, St. Lawrence, Hamilton and Saint John river basins—to mention just some of them. Canada is fortunate in having, spread across the nation, in the various provinces and among the federal government officials, a number of highly qualified individuals who know a great deal about each one of these river basins. But even in the federal government, this knowledge is disseminated throughout several departments. When it comes to irrigation uses of water, the Department of Agriculture has very knowledgeable officials. On hydrometric surveys, on the hydraulic use of water and on a number of other related subjects, officials of the water resources branch have a national and international reputation. Equally respected as regards the levels of the Great Lakes and groundwater determinations are the officials of the Department of Mines and Technical Surveys. Officials of the Department of National Health and Welfare are very knowledgeable regarding the possible damage to health arising out of pollution of national and international streams. Pollution of Canada's fresh water supplies is a matter of deep concern for members of the departments of Fisheries and of Transport, as well as to the members of the Canadian wildlife service. The Department of Public Works and the Department of Transport share an abiding interest in the navigability of waters. All these interests are

brought in focus, among federal officials, by means of an interdepartmental body known as the Advisory Committee on Water Use Policy.

The point I should like to make, however, is that this is a means of bringing into focus only the federal interests in water. What body is there, in Canada, to bring into focus the viewpoints of the provinces—as between themselves—and the provinces together with the federal government in their diverse responsibilities?

Apart from the fact that there is no one body or no group of regularly constituted bodies, save one which I shall refer to later, there are no individuals who have become, in Canada, authorities of river-basin management. We have no foundations in Canada which have supported such individual studies of the problems involved in the multi-purpose basin developments. We have not yet developed in Canada men such as Krutilla and Fox and others in the United States who have studied these matters and pointed the way to our own developments. I am referring to these authors here.

The development of our rivers must be planned to provide for domestic and industrial water supply, irrigation, recreation, power, navigation, flood control, pollution abatement, fisheries and other uses in such a way as to provide the maximum possible benefits to the nation.

Sound river basin development requires a clear recognition of the multi-purpose aspect of the problem. It requires the integrated planning of a single river basin as well as the coordinated development of several river basins within a region.

A river valley is a convenient natural area for the development of a regional conservation program because every aspect—soil, water and vegetation—is interrelated. If floods are washing away the soil, the forestry and farming practices should be reconsidered, and dams built to store the flash run-off of water. Large bodies of stored water offer possibilities for navigation, fisheries and recreation, and for the development of hydro-electric power. Alongside an improved agriculture, therefore, there may be built a new industrial complex, thus providing the balance of agriculture and industry most conducive to human welfare. This cause and effect is the basis for the planned development of river basins.

It might be useful to make a brief survey of the various regions of Canada and to point up in passing some of the emerging problems. This may help in the later examination and identification of some of the more urgent problems.

In the Pacific drainage area, such rivers as the Fraser and the Columbia require careful management and development to meet the needs of an expanding economy in that part of Canada.

The Fraser river is one which, traditionally, has provided not only a valued means of transportation but great wealth through the salmon fisheries. However, from time to time it has caused havoc to the alluvial lands on the lower mainland. One of the major problems has been to find ways of controlling the floods while preserving the navigability and fisheries of that river. The joint federal-provincial Fraser river board—which was reconstituted in 1959—is considering what means can be used to control the flood waters at an economic cost consonant with the preservation of the essential character of the river. It is thought that dykes built in conjunction with hydro-electric works on the upper tributaries of the Fraser could achieve this. However, studies costing close to $2 million will have to be carried on by this board between now and September 1, 1963 before a decision can be made on the means of controlling these recurrent and disastrous floods.

The Columbia river problem is extremely complex. At present, Canada and the United States are engaged in negotiations to determine how best to develop the potential of this river from the viewpoint of both countries. Once agreement is reached on the sharing of hydro-electric and flood control benefits,

each country will have to determine, according to the laws prevailing in their respective areas, how best to develop the water resources to meet the domestic, irrigation, flood control, water power, fishery, wildlife and recreational requirements of the region.

If one looks now at the Saskatchewan-Nelson system to the east of the rockies, one will find a whole new set of problems. When that basin was under the administrative control of the federal government together with the adjacent Northwest Territories region, there was unified control of development. The development may not have been perfect. It probably kept pace with the needs of the area. Since 1930, a new situation has developed. Now Alberta, Saskatchewan and Manitoba each own a segment of that basin. This may create serious problems in the basin unless the provinces concerned take concerted action to solve them. The prairie provinces water board, consisting of representatives of the three prairie provinces and of the federal government, has made some useful preliminary recommendations on allocations. These have been, to date, accepted by the four governments.

It does seem, however, that the population pressures are mounting on the prairies. Water being far less abundant than in other parts of the country, bitter quarrels can develop over this staff of life unless the provinces can solve the incoming problems. No permanent solution can be found, however, unless the basic facts are ascertained. How much surface and ground water is there available? What level of population, agriculture and industry can this water support? What are the best uses to which this water can be put? Have domestic uses of water, sanitation uses, irrigation uses, priority over power? What provision should be made for future navigation? These problems are unique only in their geographical context. They have arisen in adjacent areas of the United States. They have arisen in other countries of the world. However, it is only the people of the area, the people of Canada, who can solve these problems by first getting to know them and second by applying good sense in solving them.

Once you move eastwards from Manitoba, the streams do not cross the international boundary as they do, by and large, in the west. From Manitoba eastwards, streams and large bodies of water form the boundary with the U.S.A. They become, generally speaking, "boundary waters" and the rules regarding their use have been clearly set forth in the "boundary waters treaty of 1909" between Canada and the United States. Broadly speaking, each country has, in the words of the treaty, "equal and similar rights in the use" of boundary waters. Rules are set forth for disposing of these matters either by international agreement or through the International Joint Commission.

At this point, I should like to say that, over the years, we Canadians have sometimes tended to underestimate the invaluable work of this commission. We have sometimes begrudged the time it takes to solve problems. If time is necessary, it is in order to avoid arbitrary decisions. The commission has an outstanding record of achievements over many decades. Problems have been solved by giving people a forum to air their complaints, for studies to be made and for reasonable solutions being advanced. I should like to pay a warm tribute not only to General McNaughton and Messrs. Lucien Dansereau and Donald Stephens, the Canadian commissioners, but their distinguished United States colleagues, Messrs. Eugene Weber and Francis Adams. All these men devote long hours to the solution of problems which would otherwise be left to bedevil the good relations between the United States and Canada. The commission, as a quasi-judicial, recommendatory and fact finding body, has played a far greater role in settling grave water problems between two nations than most Canadians or Americans would be prepared to believe.

The problems of the great lakes—St. Lawrence are legion. The great lakes constitute such a tremendous reservoir that the flows do not vary as extravagantly as they do, for example, on the west coast. However, the density of population and the high degree of industrialization of areas bordering upon the great lakes render imperative the effective use of the water available to meet the requirements of water supply, navigation, water power, fisheries, agriculture, recreation and foreshore interests. The wondrous spectacle of Niagara Falls has to be preserved for future generations and special hydraulic measures have been undertaken.

The Saint John valley is another example of the problems incurred by man's insistent demands for energy, inexpensive transportation and recreational opportunities. Bearing in mind the multiple use of this basin, the federal and provincial governments established in March 1959 the Saint John river board. New Brunswick and the federal government are now investigating how the present and future power developments in New Brunswick would be affected by the development and operation of storage on the upper Saint John river and its tributaries. We hope to obtain a report on this subject by the end of June 1960. By this means of cooperative action with a province, we hope the water problems can be studied and solutions found for them.

In the past half hour or so, Mr. Chairman, it has not been possible to do more than to underline a few of the complexities of the water problem, its impact not only on the provinces but on whole regions of Canada, and to indicate some of the emerging problems.

It is my hope, Mr. Chairman, that this committee will examine all facets of the "water problem" in Canada. And I want to say that upon the cooperative solutions which are found will rest a good deal of the future well-being of our nation.

The CHAIRMAN: Thank you very much.

Mr. AIKEN: Mr. Chairman, I also would like to thank the minister for his statement. I wonder if he could enlarge on the division of responsibility between the provincial and federal government in this connection. I am sure this is going to keep coming up from time to time, as we proceed. For an example, I had in mind the Fraser river basin, which is entirely within one province. Using that as an example I wonder if the minister could enlarge on this just a little so that our minds might be clear, if it is clear.

Mr. HAMILTON (*Qu'Appelle*): The last conditional clause, if it is clear, points up the issue better than anything I can say. We have so recently put our minds to this question of water resources and their management that the constitutional position has not been made too clear.

In answering your question in regard to the Fraser river, the river is entirely—with the exception of one or two of its tributaries—in the province of British Columbia. Therefore, it would appear to be purely a provincial responsibility. However, there are clauses in the British North America Act—sections 91 and 92—which have not been used too extensively in Canada, but which might have a bearing on it. I will read them to you, with the idea of not putting myself up as an authority but with the idea of indicating just what the constitutional framework for responsibility is.

Sections 91 and 92 of the British North America Act confer on the federal government the right to make laws for—and I quote—

> The peace, order and good government of Canada.

And:

> Such works as declared by the parliament of Canada to be for the general advantage of Canada or the advantage of two or more of the provinces.

I think this indicates that there may be a complementary responsibility. Therefore, the next step in our reasoning might be—what has been the practice? Well, in the case of the Fraser river, the practice so far has been the cooperation in the form of the Fraser river board, which is a joint financial responsibility of the two governments to study the basin. So far there has been no federal commitment beyond the study. However, as I indicated in my opening remarks, we do have a federal responsibility in connection with fish, navigation and those which deal with some aspects of agriculture, such as irrigation. So, on those three grounds, the federal government constitutionally has an interest in the Fraser river. But the two governments are moving very cautiously on this Fraser river board, not wanting to transgress on the rights of the one or the other. I think this is where the realm of common sense comes in. I hope the two governments can deal with this matter with the attitude in mind of cooperating for achieving for the people along that river basin its maximum benefits.

Now, that is one example. I do not want to get into other touchier fields in too much detail. However, another example was hinted at in my opening remarks—that in the days when the prairie provinces and the Northwest Territories were under the federal government it would have been simple to work out an over-all physical and economical study. However, we have decided today—and rightly so—that the resources within a provincial boundary belong to that province. However, obviously there is coming a pressure of population, both domestically and industrially, for the use of that water, which makes it mandatory for the three provincial governments concerned and the federal government to get down and see if they cannot work out some sort of a common sense solution to the difficulties which are not only on the horizon but are on our doorstep. The prairie provinces water board does have cases put before it and they do make allocations of the water of the Saskatchewan and Nelson system, but so far there has been no clear-cut division of the waters of that basin, nor do I think there has been any physical study of the river basin as a whole. Obviously, so far, there has been no economic study of the river basin as a whole, and this physical and economic study that is lacking concerns itself with agriculture, forests and the run-off from mountainsides, and the use of the water along the river. This is going to be one of the major problems which might cause dissension in western Canada, and the need is obvious for some form of cooperative and coordinated attack in order to arrive at common sense decisions on the use of water.

The situation in eastern Canada is not quite so complex because the waters of Ontario are pretty well controlled by the international waters which are under the International Joint Commission, the two governments, and by the province itself. But, I am sure that there are matters that may arise in the future between the provinces of Quebec and Ontario and between the provinces of Manitoba and Ontario concerning the use of waters in their areas which cross provincial boundaries. There is cooperation at the present time between these three governments and, I trust, it will continue.

Now, in the case of the maritime area, you have rivers which cross provincial boundaries between Quebec and Labrador, and rivers that come out of Quebec and through the United States and into New Brunswick; that is an interprovincial and international problem.

So, generally speaking, with this pressure of population, with all its resulting needs, it seems evident that the time is here when committees like this one and, I hope, committees all across the country, will begin to look into this question of river basin study, or an overlapping study of regional studies of water resources in that area.

Mr. SLOGAN: I have a specific question in regard to soil erosion along the banks of the Red river. It is a navigable river, and the soil erosion arises

from four factors. First, it is a very winding river; the current is very strong and it hits one bank, reaches that bank and turns and hits the other bank. Secondly, another reason is the flooding in the spring, which causes bank erosion. Then there is the question of navigation—the waves lapping on the shore when the boats go through. This causes erosion. The fourth is the locks at St. Andrews. When they are lowered in the fall the difference in the water level causes erosion. I have a lot of people down my neck in regard to this, because a lot of their houses are practically falling into the river. Who is responsible? Is that the responsibility of the federal or provincial government?

Mr. HAMILTON (*Qu'Appelle*): I think that is a clear case of complementary responsibility. The fishing interests are not so very large on the Red river, but there is this interest in navigation which the federal government has. And then also the federal government has this interest in agriculture which along the Red river suffers from very disastrous floods.

There is a city called Winnipeg, in the path of that river, and that is where the maximum damage occurs in the flooding.

There is another argument which you have not mentioned, that most of these waters which come down and flood the river do not originate in Canada. That is one of the unsolved problems that is presented. Now, just what is the position?

I might give you a precedent for this, but I do not think it would work out in the case of the Red river because the effect has been going on for too long. But in the matter of building storage reservoirs on the Columbia river, we hope to collect payment from the United States for preventing flooding in downstream flows. So this is a cooperative deal between the two countries.

It has not yet been posed, to my knowledge, on the Red river. So I think the answer to your question is that it is a complementary responsibility. That was, I think, the main reason the federal government accepted the same financial responsibility in relation to Manitoba flood control measure, as was recommended in the report of the royal commission of 1956, I think it was.

Mr. SLOGAN: The Manitoba government made it clear that it would be very economical to build a dam across the Red river at Emerson, but that it would flood out Minnesota and North Dakota. So I think the federal government has a certain responsibility in it.

Mr. KINDT: Might I ask the minister about soil conservation, just to clarify the thinking on responsibliity. For instance, on farms you have soil erosion and the need for water conservation. Well, soil erosion leads to damming streams, and all the rest of it. Might I ask if the practices which are needed on farms to control soil erosion are federal or provincial matters?

Mr. HAMILTON (*Qu'Appelle*): I always qualify my remarks with the fact that I am no authority on this subject: but generally speaking I think that flooding and irrigation fall within the local areas of the province, and that the agricultural area could be looked at as a provincial responsibility.

Two acts were passed by the federal government, I suppose under the provision relating to the best interests of the national well being, the first of which is called the Prairie Farm Rehabilitation Act, which deals with the lower part of the prairies and part of the rivers only, and the second called the Maritime Marshland Rehabilitation Act. These are one-hundred-per-cent federal activities which do carry out certain practices which, first of all, store water for the use of farm families, and secondly, do preserve water from passing downstream. The main reason for them is to supply and provide water for irrigation, the watering of cattle, and so on. That in substance is about the limit of my knowledge on that question. But generally speaking most of the provinces have conservation acts which deal with flooding and with the damming up of water in the provinces.

Mr. SIMPSON: Mr. Minister, in regard to water pollution of an interprovincial stream, going back a few years ago you will recall the trouble on the Saskatchewan river when I think it was eventually decided that there was industarial waste from the city of Edmonton. Do you know if this question was officially resolved strictly through the provincial bodies, or did the federal government come into the picture at all? I ask this question because I have seen something of the same nature in other districts, and I was just wondering how to get a solution of it in connection with interprovincial waters.

Mr. HAMILTON (*Qu'Appelle*): With the same qualification that I stated as a prelude to my answering the previous question, I am not an expert in these matters. But if my memory serves me correctly, first of all the federal government has firmly stated, I think, that they disclaimed responsibility in the case of Alberta and Saskatchewan; and I believe, if I remember correctly, that the Alberta government was rather reluctant to take steps—strong steps. But I think the final solution came when the company did take certain steps which tended to reduce the amount of pollution.

I might say that because of the touchiness in this type of thing, and the responsibility between the provinces and upstream and downstream users, that it bears out my contention for the need for more cooperation between the provinces in these problems, when we might sit in as an honest broker, trying to arrive at an equitable decision of these matters. Everyone who hears of it in Canada accepts the proposition that the province should have control over its own natural resources. But the fact is that such things as pollution do not always stop at meridians, longititudes, or provincial boundaries. They go across; they cut across river basins and through regions.

Therefore the time has come in the eyes of people of the twentieth century to sit down and work out cooperative solutions for these problems. It may be that the answer in the west lies in giving the water to the prairie provinces to a water board, a quasi judicial board, to which all governments and individuals could refer problems, which board would see that orders were carried out. That is, the province would still control its own waters, but it would delegate part of its rights to a quasi judicial body.

The other solution of course is the far-reaching solution to set up a river authority, and to place matters relevant to the use of waters in that river in their hands, with very large powers. These seem to me the two alternative courses that any solution would tend to follow, or would tend to recommend.

Mr. KORCHINSKI: Did I understand the Minister to say that it was in 1930 that the prairie provinces were given the rights to their own natural resources?

Mr. HAMILTON (*Qu'Appelle*): The two provinces of Alberta and Saskatchewan.

Mr. KORCHINSKI: What act or agreement was it that set that out?

Mr. HAMILTON (*Qu'Appelle*): There was federal legislation. I think it was called the Natural Resources Transfer Agreement. I understand that Manitoba was also in there. This was an act of the federal government and it was confirmed by an amendment to the British North America Act.

Mr. KORCHINSKI: Is there someone here who could give us a rundown of the agreement that was set up at that time?

Mr. HAMILTON (*Qu'Appelle*): That is a very difficult question, but while my people are getting their information collected, I can give you what I know of it historically.

In 1905 when the provinces of Alberta and Saskatchewan were carved out of the territories, their natural resources were reserved to the federal government.

This precipitated a long difference of opinion between these provinces and the federal government. This political difference was resolved in 1930 by the passage of the Natural Resources Transfer Act which gave to the two provinces their natural resources.

Previously, in British Columbia, there had been an order reserving the general resources for the federal government along the railway belt. But Ottawa turned them back to the province of British Columbia in 1912 and 1913. That is the background as far as the western provinces are concerned with respect to natural resources.

In the eastern provinces, under the British North America Act there was listed under the various sections the powers of each of the original joiners of Confederation, and that is why they never had this difficulty with the federal government which existed with respect to Alberta and Saskatchewan and the federal government particularly.

Mr. KORCHINSKI: Does this agreement set out to what degree the federal government will participate in the development of those resources?

Mr. HAMILTON (*Qu'Appelle*): No, it just says which powers the provinces have and which powers the federal government has, and that residual powers belong to the federal government.

The CHAIRMAN: Are there any general questions which can be asked of the minister? If so, we would appreciate having them now. I think the steering committee will work out a plan of attack, as you might say, on this question of water resources, and we will probably deal with them by regions, by drainage systems, or in some form like that so that we may deal with each one of them is of interest to any member of the committee, fairly and fully. Are there any more questions on general policy?

Mr. MCFARLANE: Mr. Chairman, I would like to ask the minister whether, in the case of international rivers, the international section of the river come under the jurisdiction of the province or of the federal government? I think my question is supplementary to Mr. Nielsen's, but I do not think the answer to his question was quite what I was looking for.

Mr. HAMILTON (*Qu'Appelle*): Do you define an international river as one which runs along the boundary? Is that what you mean, or is it one which crosses a boundary?

Mr. MCFARLANE: No, I mean one that crosses the boundary.

Mr. HAMILTON (*Qu'Appelle*): There is a difference. To which do you refer?

Mr. MCFARLANE: I suppose the Columbia may not be discussed at this time?

Mr. HAMILTON (*Qu'Appelle*): Oh yes, you may discuss the Columbia as long as you do not go into the subjects which are under negotiation.

Mr. MCFARLANE: Relating then specifically to the Columbia river, does the Columbia river in British Columbia come under federal or under provincial jurisdiction?

Mr. HAMILTON (*Qu'Appelle*): It is under provincial jurisdiction, but there is an overriding boundary waters treaty or act of 1909. It evolved the theory that waters originating in one country belong to that country. This was a new theory in British law.

Then in 1943 or 1944 there was a reference to the International Joint Commission about the Columbia river. That did not refer to a river between two countries. The province of British Columbia went ahead and began to make arrangements to develop the Columbia river. In 1955 the federal government interfered by passing the International River Improvements Act, which

reserves the power to the federal government,—because it is a river which passed over the boundary,—to license international river improvements so as to ensure that the waters originating in Canada are developed and utilized in the national interest.

This act was passed on July 11, 1955. The act does not apply to international river improvements constructed under the authority of an act of the parliament of Canada, nor to the improvements stated within boundary waters as defined by the boundary waters treaty of January 11, 1909. That is why I think there is a difference. This is an international improvements act, and it refers only to rivers which cross a boundary, and not to boundary waters.

Mr. McFarlane: As to the section of the Columbia river which is entirely within British Columbia, does it come under federal jurisdiction, or does it come under provincial jurisdiction?

Mr. Hamilton (*Qu'Appelle*): It comes under both jurisdictions. They have a board which licenses improvements on the river. But we have the right under this International River Improvements Act to license, as well. And what we do is to consider any projects proposed to see if they are in the national interest. So we do have a type of veto over any improvements on that river.

Mr. McFarlane: Actually the responsibility lies with the province?

Mr. Hamilton (*Qu'Appelle*): Yes.

Mr. McFarlane: I have a problem in that area with the Kicking Horse river where it joins the Columbia river. Due to silting it carries refuse downstream which creates a problem right where it joins the Columbia. Part of that area could possibly be flooded due to this silting.

The angle I am getting at is, where does the responsibility lie? Apparently this was brought to the attention of the boundary province and of the federal authorities, and we are not getting anywhere.

Mr. Hamilton (*Qu'Appelle*): Under the definition I have been trying to put forward today I would say that this is a provincial responsibility, but I think we have the negative power of licensing any improvement on the river. But it is their responsibility to propose the work, and as long as it does not hurt anything in the national interest, we accept it.

The Chairman: The Kicking Horse river originates in one of the national parks. What is the federal responsibility there? If you cannot answer the question today, Mr. Minister, all right.

Mr. Kindt: I would like to ask the minister another question. We would not get very far in this discussion before we got into the question of vegetative coverage; I mean forests, farms, and the vegetative cover to retard water runoff and to prevent soil erosion. Whose responsibility is it? Is it that of the dominion or the provinces, to get into this question which concerns vegetative covering? This is a vital issue, and a lot of our discussion in this committee will center around it.

Mr. Hamilton (*Qu'Appelle*): Using once again the definition I have just given, if that forest covering lies within the provincial boundary, then it is the responsibility of the province. But the federal government would assure its concern in this matter. Some years ago the federal government entered into a joint agreement with the province of Alberta to have joint development of the eastern rockies under a board known as the Eastern Rockies conservation board. The capital expenditures have been made and the province supervises the operations of that board. We do have one member on it now and the province has two. So we just keep an eye on their activities to protect the federal investment in an attempt to protect that watershed. It is a provincial responsibiliy,

but the federal government has a great interest in it because the headwaters of all the prairie rivers come from that eastern rockies conservation board area.

Mr. AIKEN: I have been trying to sort this out. Perhaps the minister will tell me whether or not I have sorted it out correctly. In a lot of these matters such as the Fraser river for example, conservation, as the maintenance of a national resource, is the responsibility of the federal government and the federal government has the power to move in where the national interest is involved—but not necessarily the responsibility in a lot of these things—under the general clause for peace, order and good government of Canada. Is that a fair statement?

Mr. HAMILTON (*Qu'Appelle*): It is a statement which has not been demonstrated in practice. I did read those sections 91 and 92 which quote the good order clause of the British North America Act. I have tried to make it clear here that the responsibility for all the resources within a provincial boundary is on the province. They have jurisdiction over management. However, a thought which I would like to express is that perhaps the time has now come when the provinces should get together on problems of a regional nature in order to discuss the resources in that area to get the maximum advantage for all concerned. The federal government does have an interest in this. We have taken the lead in calling the provinces into conference with us preliminary to a conservation conference at which all these problems which we have before us now will be discussed. It is the objective of the conference, within the terms of the B.N.A. Act where all resources belong to the province, to suggest a series of principles under which governments at all levels, and other agencies of government such as conservation boards, can act. I should have included in that statement private business as well.

I think that indicates the attitude of the federal government. First we recognize that the ownership and management responsibility of these resources belongs to the provinces, but in this modern day with the pressures of population on our navigation and bodies of water we have taken the lead in trying to get the provinces to come together and work out these principles which will be for the general good.

In other words, there is no big stick technique which I think was inherent in your question. It is rather a question of leadership so that responsible sovereign bodies can make decisions in respect of their own and other problems nearby.

Mr. AIKEN: In several cases you have mentioned where the federal government has moved in to assist where they thought the national interest was involved in cases where they would never accept responsibility. You mentioned some instances in the prairies and in the maritimes where the federal government did move in to help in the situation.

Mr. HAMILTON (*Qu'Appelle*): Yes. I think that is compatible with what I have said. The federal government has a great interest in this and does feel the necessity in the national interest to assist. We have done it in Ontario as well.

The Conservation Act which is under review in these votes is one where we have helped out in four or five cases in Ontario to conserve water. There is no responsibility on the federal government, but in the national interest we do offer assistance.

Mr. KORCHINSKI: I would like to clarify something. Any legislation which may be brought in in the future would have to be in a manner in which the federal government merely cooperates with the provinces. It seems to me the provinces have the right over their natural resources.

Mr. HAMILTON (*Qu'Appelle*): What you say is essentially true with the exception of waters which comprise a boundary. In that case we have an international responsibility.

Mr. DOUCETT: Is there anything defining the responsibility in respect of navigable waters such as Lake Ontario, where there are great inroads which take away buildings, transportation arteries and so on? In the past there has been great argument as to who is responsible and it generally goes on until some houses disappear, a road disappears or something like that. It also happens in Lake Huron. In those two places, Lake Ontario and Lake Huron, there has been great erosion of huge quantities of soil and there are places in which it goes inland probably a quarter of a mile.

Mr. HAMILTON (*Qu'Appelle*): It is very difficult to give an answer. As I am not an expert I will have to qualify my answer. Generally speaking, however, the resources do belong to the province and we have responsibilities, for instance, for navigation. So there is a complementary responsibility. There is another factor. Certain things are just caused by nature for which no one is responsible; it is an act of God, a subject in respect of which I do not think the constitutional lawyers ever decided—as to who is responsible for an act of God.

I think you all know that Lake Ontario is settling a little in the east end. This causes a change in the water levels. So far as I know, no government, either federal, provincial or international, accepts the responsibility for this shifting of the earth's structure at the bottom of the lake. This is a question which is away over my head.

Mr. DOUCETT: I have often wondered whether or not the pumping of thousands of tons of sand out of Lake Ontario changed the condition of the water and caused some of the erosion. I do not know; I am not an expert either. In the summer they go in there with barges and they take out large quantities of sand for building purposes and so on. From the standpoint of a layman it would appear that might change the general condition.

Mr. HAMILTON (*Qu'Appelle*): You are referring to an engineering aspect on which I am not an authority. Might I ask Mr. Patterson, who does the studies for me and who has done a remarkably good one recently, to speak on the general aspects of these questions in respect of the physical changes in a lake like Lake Ontario.

Mr. T. M. PATTERSON (*Director, Water Resources Branch, Department of Northern Affairs and National Resources*): Mr. Chairman, Mr. Minister, and members of the committee, with regard to the question which was just asked, as I understood it, it was as to what effect the dredging out of large quantities of sand from the lake bottom would have on the surrounding areas and whether or not it might cause additional erosion.

Mr. DOUCETT: Yes.

Mr. PATTERSON: Actually while the quantities of sand may seem quite large in a body of water like Lake Ontario or Lake Huron, they are infinitesimal. At the outlet of Lake Huron there has been considerable dredging and boring of sand and there has been improvement in the navigation channels through the lower levels. This dredging in the navigation channels has been done by the United States at their cost and after consultation with Canada. Based on studies which were made as to what effect that might have, they did put in compensating works in the river channel in the form of underwater dykes which were not in the navigation channel proper, but in other sections of the river, so that Lake Huron would not tend to lower due to the increased outlet capacity in the navigation channels. In so far as it has been possible to study that question, the effects of any work in recent years have been fully compensated for through the construction of these dykes and other means which have been taken.

The CHAIRMAN: Thank you very much, Mr. Patterson. I think we will have an opportunity to go into these problems in more detail at a later date when Mr. Patterson will be with us.

Mr. SIMPSON: I was wondering whether or not there has been any recent change or any recent acceptance of the definition of navigable waters? I am saying this because it might be wise for the committee to take a look at the definition, or the accepted definition of navigable waters due to the opening up of certain areas in the north. We have waters up there in respect of which it might be difficult for us to know whether or not they are acceptable as navigable waters.

Mr. HAMILTON (*Qu'Appelle*): The only suggestion which comes to my mind in answer to that question is first of all I think I would like to take it as notice so that we might prepare some sort of a story for the committee in respect of what has been the definition in the past and then apply it to the future. Secondly, there is an international responsibility on navigable streams and this could be reported in the same paper.

If I had a clear indication from Mr. Simpson as to just what particular problem he is thinking of, I could probably try to answer that in the report.

Mr. SIMPSON: It is a little difficult to explain. However, there is the Red river in Manitoba. I know the river very well. We all call it a navigable water. We have many streams in the northern part of the province which may be far more navigable than the Red river. I would like to know, for instance, if they are classed as navigable waters.

Mr. HAMILTON (*Qu'Appelle*): I think the answer to that is if they are navigable they are navigable waters.

Mr. SIMPSON: Navigable for what size of shipping?

Mr. HAMILTON (*Qu'Appelle*): On that point this comes to my mind: In the days of navigation on the northern rivers it was mostly done by canoes and bateaux, and on the Mackenzie river it was by steamboat and tugs. The Yukon river until recently was navigated by grade 2 and 3 steamers, paddle wheel steamers. When we built the bridges across the river we assumed the river was navigable and the bridges were a height which would allow what we thought would be the type of navigation on the river. I think that is a technical test which has been applied. It is obvious when they built a bridge across the St. Lawrence it was built to carry the big ocean steamers, so the pragmatic test is the improvements on the rivers.

Mr. SLOGAN: When you are presenting the report would you also include the responsibility of the federal government over navigable rivers, particularly as it affects the problem of erosion on the banks.

Mr. HAMILTON (*Qu'Appelle*): Yes. We could add that to the report.

Mr. AIKEN: At one time I had the opportunity of looking into this subject of navigable waters and I have never seen a definition other than something like this, that a navigable water is one upon which navigation can be carried on. I do not think it has ever been defined.

Mr. KINDT: Would it be possible for the department to provide us with a copy of the 1930 act which turned over the resources to the prairie provinces, Alberta and Saskatchewan.

Mr. HAMILTON (*Qu'Appelle*): Yes.

Mr. KINDT: Thereby we would have the background.

The CHAIRMAN: Gentlemen, this room is required for another committee meeting at 11.00 o'clock. You can see that we have many conundrums facing us in the discussion of these estimates. I would like to meet with the steering committee—I will call them as soon as possible—so that we can plan our discussions. We hope to try and get General McNaughton here at our next meeting, which will be next Monday at 11.00 o'clock.

Our meeting days and hours are Monday at 11.00 o'clock and Tuesday at 9.30. In the meantime, if you will give some thought, especially those of you on the steering committee—or anybody else who has any ideas—to some plan of procedure. A motion for adjournment, please?

Agreed.

Committee adjourned.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 2

MONDAY, MARCH 28, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESSES:

Mr. E. A. Côté, Assistant Deputy Minister of Northern Affairs and National Resources; Mr. T. M. Patterson, Director, and Mr. J. D. McLeod, Chief Engineer, of the Water Resources Branch.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22857-7—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.
*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, March 28, 1960.
(3)

The Standing Committee on Mines, Forests and Waters met at 11.00 o'clock a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Cadieu, Coates, Doucett, Fleming (*Okanagan-Revelstoke*), Gundlock, Kindt, Korchinski, MacRae, Martel, McGregor, McQuillan, Mitchell, Muir (*Cape Breton North and Victoria*), Nielsen, Payne, Robichaud, Simpson, Slogan, and Stearns—(20).

*In attendance: From the Department of Northern Affairs and National Resources:* Mr. E. A. Côté, Assistant Deputy Minister; Mr. T. M. Patterson, Director, Water Resources Branch; Mr. J. D. McLeod, Chief Engineer, Water Resources Branch, Dr. K. Kristjanson, Secretary, Advisory Committee on Water Use Policy.

The Committee resumed its consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Copies of the following documents requested at a previous meeting were distributed to the members of the Committee:

The Alberta Natural Resources Act, 1930
The Alberta Natural Resources Act, No. 2 (1931)
The Natural Resources Transfer (Amendment) Act, 1941
The Alberta Natural Resources Transfer (Amendment) Act, 1945
The Railway Belt and Peace River Block Act (1930)
The Manitoba Natural Resources Act (1930)
The Manitoba Natural Resources Transfer (Amendment) Act, 1948
The Saskatchewan Natural Resources Act (1930)
The Saskatchewan Natural Resources Act, No. 2 (1931)
The Saskatchewan Natural Resources Act, No. 3
The Refunds (Natural Resources) Act (1932)
The Natural Resources Transfer (Amendment) Act, 1938

The Chairman advised that the definition of navigable waters requested at a previous meeting will be submitted shortly by the Department of Public Works as navigable waters are under their jurisdiction.

Mr. Patterson, Director of the Water Resources Branch, read a prepared statement reviewing the history and responsibilities of his branch and was questioned thereon.

Mr. Robichaud requested that, in future, when prepared submissions are to be presented, copies be made available to members of the Committee.

Copies of a document entitled "The Distribution and Measurement of Surface Water in Canada", by Messrs. J. D. McLeod and R. H. Clark, were distributed to the Committee.

Mr. McLeod, Chief Engineer, Water Resources Branch, supplemented Mr. Patterson's statement with additional detail on the organization of the Branch and also dealt with various aspects connected with water resources.

Messrs. McLeod, Patterson and Côté were questioned.



22857-7—1½

The Chairman announced that Mr. McTaggart-Cowan, Director of the Meteorological Service of the Department of Transport, would appear before the Committee on Friday, April 1; Mr. Fox, a United States authority on water problems, would attend on Tuesday, April 5, and General A. G. L. McNaughton would attend during the month of May.

At 1.00 o'clock p.m., the Committee adjourned until 9.00 o'clock a.m. Friday, April 1, 1960.

M. Slack,
*Clerk of the Committee.*

# EVIDENCE

MONDAY, March 28, 1960.
11 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. Initially, we will deal with a couple of matters which came up at the last meeting.

A request was made for copies of the acts concerning natural resources. There are twelve acts. Dr. Ollivier has had mimeographed two of them so, you have a complete set. They are available at this time for distribution and I would ask that they be passed out to the members.

Also, there is one other matter which I wish to deal with at this time. Someone asked for a definition of "navigable waters". I am told that a request has been made to the Department of Public Works, under whose jurisdiction navigable waters come, to prepare a definition, which will be submitted some time later.

Gentlemen, we have with us this morning Mr. T. M. Patterson, director of the water resources branch of the Department of Northern Affairs and National Resources, and we will call on him to give us an outline of the present activities of the branch.

Mr. MARTEL: Mr. Chairman, before we proceed, I would like to mention that we have in attendance Mr. J. A. Schryburt, director of public relations, Canadian lumbermen's association. The lumber industry has a great interest in water resources because of its influence on the forests and the forests in-uence on waters. Could Mr. Schryburt have the privilege of attending the sessions?

The CHAIRMAN: We are happy to have Mr. Schryburt with us this morning.

Mr. T. M. PATTERSON (*Director, water resources branch, Department of Northern Affairs and National Resources*): Mr. Chairman and members of the committee:

Your decision to hear from officers of the water resources branch at this time is, to my mind, a good one. Consideration of the estimates of this branch is one of your ultimate goals and it seems appropriate that at an early stage you should have presented to you the place which the branch activities take in the broad program of assessment and study of problems associated with water that was outlined to you by my minister, the Hon. Mr. Hamilton, at your opening meeting last week. In a country such as ours with its vast areas, its variety of soils and vegetable cover, its distribution of population and of industry in all its forms and, above all, its climatological and topographical extremes, water problems are legion and may be expected to increase with the advance of our country.

At today's session I propose to outline to you in their broader aspects some of the duties and responsibilities as well as the history of the water resources branch and to have Mr. J. D. McLeod, chief engineer, follow with a more detailed account of the branch organization and the manner in which we carry out our basic responsibility in recording the surface waters of the country. Mr. McLeod and Mr. R. H. Clark, the chief hydraulic engineer, are invaluable assistants to me and I credit them together with a hard working and efficient staff with the degree of success that I consider we have achieved and are achieving in our undertakings.

Mr. Clark, who received a severe shaking up in the accident which resulted in the death of Mr. Tom Foley recently, is presently catching up on an urgent assignment but will appear before you at a later date to outline to you some of the hydrologic studies concerning conservation and flood control to which our hydrometric data are essential. It may well be that Messrs. McLeod, Clark and I will appear before you at various sessions to present branch activity in studies of particular interest to you. I understand that at a later session I may be expected to cover our participation in the work of the Fraser river board. These appearances together with the questions which you undoubtedly will put to us should give you a valuable insight into the activities of the branch. May I add that we will take pleasure in fulfilling these responsibilities to your committee.

The basic function of the water resources branch is the systematic recording of surface water level and flow data across Canada. The branch operates through a head office in Ottawa, six district offices located at Halifax, Montreal, Guelph, Winnipeg, Calgary and Vancouver and a number of small sub-offices strategically located for conducting field work. Flow data are essential to proper planning and design of projects for water supply, power generation, irrigation, reclamation, flood control, recreation and for water conservation and demands for records are becoming more numerous and more insistent. The branch operates a growing number of gauging stations (over 1200) where levels are obtained daily or more often and where velocity measurements are recorded and related to the levels to provide a continuing inventory of the water available in the rivers measured.

It is of prime importance that the methods of obtaining water records across the country should be uniform and that the period of record be continuous over a substantial number of years. These requirements, coupled with federal responsibility for navigation and international problems, offer good reasons for federal participation in a continuing hydrometric survey. The provinces have been happy to enter into co-operative financial arrangements relative to the work conducted for them. Co-operation is maintained with other federal agencies and municipal and private organizations with the result that there are published in Ottawa biennial compilations of water data for the four drainages of Canada similar in content to that for the climatic years 1955-56 and 1956-57 for the Arctic and western Hudson bay drainage which is our water resource paper No. 121, just off the press. And I have a copy of that document here which is a compilation of the flows in the various streams which we measure in this particular drainage which is the Arctic and western Hudson's bay, and the western Mississippi basin in Canada.

The first recorded stream measurement forming part of a hydrometric survey was made in June, 1894, on the Bow river near Calgary. For more than a decade thereafter general hydrometric work was confined to irrigation surveys undertaken in Saskatchewan and Alberta. Then, in 1908, parliament made an appropriation of $10,000 for the establishment of systematic stream measurements, and a "Hydrographic Surveys" section was formed in the Department of the Interior.

While the hydrometric survey was becoming established in Alberta and Saskatchewan, other circumstances were bringing about its introduction west of the rockies. Under the terms of union admitting it into Confederation, the province of British Columbia conveyed to the dominion government a strip of territory more than 500 miles long and 40 miles wide along the prospective route of the Canadian Pacific railway. By 1911 the administration of water powers and water rights in this railway belt and on other dominion lands had become so important that a water power branch was formed in the Department of the Interior. This branch was made responsible for the hydrographic survey of the railway belt and of Manitoba, and also conducted

water-power surveys in Alberta and reclamation and water-power investigations in Saskatchewan.

Until 1913 the hydrometric survey operations carried out by the federal government were limited to areas in which it had a proprietary interest; that is, in the prairie provinces, where waste lands and ungranted lands were reserved (until 1930) to the crown in the right of Canada, in the railway belt, and in the Yukon and Northwest Territories. In 1913, however, the federal government entered into a co-operative agreement with the government of British Columbia, at the latter's request, whereby the surveys already conducted in the railway belt would be gradually extended throughout the province. This agreement was the forerunner and the model of corresponding agreements signed with the other provinces. Terminated during the depression of the 1930's these agreements were afterwards succeeded by individual agreements with each province (Prince Edward Island excepted) for the continuation of a uniform hydrometric program by the federal government. In 1950 an agreement with Newfoundland extended the survey to that province.

The centralized direction and control of the hydrometric survey has marked advantages. The logical unit for the investigation and development of water resources is the individual drainage basin. In Canada political divisions do not often coincide with phyical divisions, and many important drainage basins extend across interprovincial and/or international boundaries, imposing special responsibilities upon the federal government. Under a national hydrometric survey, stream-gauging stations can be established at the most suitable locations without regard to internal boundaries. Methods of field investigation and of office computation can be standardized from coast to coast. Duplication of survey work by federal and provincial authorities is avoided.

While the collection of stream flow data is an essential part of the branch's activities, it is the application of these data to the solution of the many hydraulic and hydrologic problems that are referred to the branch that offers continuous interest and challenge to the trained minds of the engineers on the staff.

For many years the department and branch have had responsibility for advising the Department of External Affairs on international water problems. The branch officers and facilities have assisted the International Joint Commission on innumerable occasions and the branch has continuing membership on some twenty Boards appointed by the International Joint Commission or the government of Canada to prevent or dissolve irritations arising from water use problems along the international boundary.

In the national field the branch becomes involved in many other challenging water problems and there is every evidence that these will increase many fold as the country's growth places greater and greater demands on our water supply and its wise use and as the need for conservation and flood control measures become more urgent.

There have been distributed to you samples of branch publications which convey some part of our activities and together with the foregoing introductory statement permit a closer look at the detail of our organization. With your permission I would suggest that you next hear from Mr. J. D. McLeod, Chief Engineer of the Branch.

The CHAIRMAN: Thank you very much, Mr. Patterson. Anybody have any questions of Mr. Patterson?

Mr. ROBICHAUD: Mr. Chairman, would it be more convenient for the members if any further reports be presented, either by officials or members, that mimeographed copies be submitted to the members? It would be much easier to ask questions if we had those copies in front of us.

The CHAIRMAN: Yes, thank you Mr. Robichaud. In respect of any further information which is presented by members of the department, we have them mimeographed? There are 35 members of our committee and if we could have 35 copies it would help matters.

Mr. AIKEN: Are these stream gauging surveys done by your department or by Technical Surveys?

Mr. PATTERSON: The stream gauging program throughout the country is carried on by our branch, sir. Mines and Technical Surveys operate level reporting gauges on tidal waters and in the Great Lakes for hydrographic chart purposes.

Mr. AIKEN: I knew that Mines and Technical Surveys did a considerable number of these tests and I wondered what the division was. They are just on the Great Lakes and on the coastal waters?

Mr. PATTERSON: That is right, and they are not concerned with the flow of water; they only record elevation and they do not tie that into discharge.

Mr. AIKEN: Thank you.

The CHAIRMAN: Any further questions from Mr. Patterson?

Mr. MARTEL: Mr. Patterson, I understand there will be a study made of each different area we have covered. I understand there has been a survey made in what I would call the Hudson bay basin, the Rupert river and the Bell river.

Mr. PATTERSON: We are operating gauges on those rivers in cooperation with the Quebec hydraulic resources branch.

Mr. MARTEL: In reply to a question by Mr. Korchinski, who asked:

> Any legislation which may be brought in in the future would have to be in a manner in which the federal government merely cooperates with the provinces. It seems to me the provinces have the right over their natural resources.

—The minister said:

> What you say is essentially true with the exception of waters which comprise a boundary. In that case we have an international responsibility.

Would that mean that those resources in the north on Hudson's bay or James bay basin be considered as boundaries because they come into the basin?

Mr. PATTERSON: No sir, the only reason that the federal interest is in there is through agreement with the province of Quebec. The province of Quebec has recognized the desirability of uniform records across the country, so that when a flow is given in British Columbia it means the same thing as a similar flow given in the province of Quebec. For many years we have had very fine cooperation with the province of Quebec through the Quebec hydraulic resources branch and the Quebec streams division.

Mr. CÔTÉ: I think when the minister used the words "boundary waters" he had in mind the term used in the Boundary Waters Treaty of 1909, namely, those waters through which the international boundary runs.

Mr. MARTEL: With the United States?

Mr. CÔTÉ: Yes.

Mr. MARTEL: Not between each province?

Mr. CÔTÉ: No; I think, when he said that, Mr. Martel, he had in mind the international boundary waters.

The CHAIRMAN: Well, if there are no further questions of Mr. Patterson I think we will thank him very much and Mr. McLeod, I understand, is going to report.

Mr. J. D. McLeod (*Chief Engineer, Water Resources Branch*): Mr. Chairman and members of the committee. The work of our branch Mr. Patterson has just given you is a general outline of the fields of work covered in the branch, and he has asked me to supplement this as far as I can with a little more detail on the organization of the branch, with particular reference to its work in stream measurement.

The shortage of time did not permit me to prepare a formal paper. However, I am going to refer to some extent to an address which was given before the Royal Society of Canada about two years ago on this same subject, and with the permission of the chairman I have here 50 copies of that document which perhaps you might want to have distributed.

The Chairman: Thank you very much.

Mr. McLeod: I should warn you specifically that I do not intend to follow it page by page and paragraph by paragraph, but it does provide perhaps a little reference material which you may find interesting.

Now, as Mr. Patterson has said, the work of the branch in the stream flow and water level measurement field is carried out through the operations division of the branch which consists of 141 full time classified employees plus a number of prevailing rate employees, student assistants and casual labour.

Those people are distributed among the seven offices, that is, the branch head office in Ottawa and the district offices at Vancouver, Calgary, Winnipeg, Guelph, Montreal and Halifax as well as in the 15 small sub offices which are operated in conjunction with the district offices of the districts where they are located.

Perhaps I can give you—although this is not the best map—an indication of the area covered by each district office.

Vancouver covers the entire province of British Columbia plus the Yukon territory, and an adjacent strip of the Northwest Territories. For work purposes we have the country divided along lines which have in part been dictated by convenience of access and transportation rather than specific provincial or territorial lines.

Under the district office at Vancouver we have a sub-office at Whitehouse, another one at Prince George, another one at Kamloops, another one at Nelson, and another one at Cranbrook. These are all small offices with from one to four employees at each and their purpose is principally to have a field representative in these areas for convenience of operation.

Similarly, we have in Alberta a large part of Saskatchewan and a strip of the Northwest Territories, including much of the Mackenzie river drainage with a district office at Calgary. We have sub-offices at Saskatoon, another one at Shaunavon, which is a very small community in the southwest corner of the province of Saskatchewan.

The Winnipeg district office covers the province of Manitoba, a strip of Keewatin territory immediately northward from Manitoba, a small part of the province of Saskatchewan where the run-off is from the Souris and Assiniboine rivers, that is, to rivers which flow through Manitoba and also that part of Ontario from Lake Nipigon west. That is principally a geographic convenience. Winnipeg is so much closer to the western Superior area and the Lake of the Woods and Rainy river area than it would be from Guelph.

The Guelph office covers the remaining part of Ontario from a line approximately east of Lake Nipigon throughout the whole area. There are two sub-offices in Ontario in the northwest which are responsible to the Winnipeg district office. They are located at Keewatin, the outlet of the Lake of the Woods and Fort Frances, the outlet of Rainy lake and a staff is kept there primarily to secure recording information for certain of the governments international and inter-provincial commitments with regard

to the Lake of the Woods. Convention and Protocol and Rainy lake Inc. orders. Two other sub-offices located in Ontario are one at Niagara Falls and the other at North Bay. The North Bay office is there to service that part of northern Ontario including the Abitibi, Mattagami, White river et cetera. We have to keep staff in the Niagara Falls sub-office in order to secure detailed information from the power entities on both sides of the border to ensure that the provisions of the 1950 Niagara treaty are being observed by both countries.

In Quebec province, the survey is operated in the Montreal district office with a sub-office located at Senneterre, for work in northwest Quebec and another sub-office at Rimouski for the lower St. Lawrence and Gaspe area. A further sub-office will be in operation at Seven Islands I expect this year.

In the Maritime provinces the district office at Halifax looks after all work in Nova Scotia, New Brunswick, with a sub-office at St. John's which does all the work for the island of Newfoundland.

The branch work in Labrador is covered by the Halifax office rather than from St. John's simply because with existing airline arrangements it is easier to get from Moncton to Seven Islands, the base of the charter planes at the present time, than it is to go from St. John's.

As Mr. Patterson has mentioned, in the hydrometric surveys there are about 1,200 gauging stations. I think at last count it was about 1,268. That is at March 31, 1959.

These are distributed by provinces; 332 in British Columbia, 154 in Alberta, 151 in Saskatchewan, 123 in Manitoba, 215 in Ontario, 194 in Quebec, 13 in New Brunswick, 18 in Nova Scotia, 20 in Newfoundland, 40 in the Yukon territory and 8 in the Northwest Territories. The reason, of course, for the disparity in numbers is that the gauging stations are installed normally for one of two over-all purposes, one, the desire on the part of the branch itself or upon the part of one of the provincial cooperating agencies for additional information on a particular river or rivers; secondly, in the territories the requirement that the branch along with other parts of this department of Northern Affairs and National Resources endeavour to appraise the water resources of those territories which are still under federal government control.

Now, with that short run down on the organization I would like to say a few things about factors affecting run-off, because these factors are the basis of the requirement for work of this nature.

Now, in the paper which has been handed around there is a short paragraph on this subject commencing at page 1 which states that water, as found in the lakes, streams and oceans, is being renewed constantly by precipitation in its various forms, and is transported from place to place in either surface or underground channels. On the other hand, it is being diminished constantly in quantity by the various agencies of percolation, transpiration, evaporation and run-off; these several agencies have widely varying effects from time to time and place to place. Consequently, the amount of water present at any specific time at any particular place is an extremely variable quantity because of the interaction of many inconstant factors.

An example of the great variability of stream flow at a particular place over a period of time occurs on the Red river at Emerson, Manitoba, where the drainage area is approximately 40,000 square miles, and the flow has been recorded systematically for 45 years. The river flow at this station varied from almost zero during several days in February 1937, to about 95,000 cubic feet per second in May 1950, and there is evidence that within the last 150 years there were floods which exceeded this recorded maximum.

The factors affecting stream flow, although they may be subject to direct measurement for any given instant of time, cannot be predicted beyond that

instant with any degree of certainty. As a result of this uncertainty of prediction, it is necessary, in all planning for the conservation and development of water resources, to adopt a method that assumes that future variations will follow the same general pattern as past variations. This method involves as its cardinal principle, the systematic collection and compilation of all data pertaining to water supply for sufficient periods of time to cover the variations that are likely to occur. Among the more important of these data are records of precipitation, temperature, evaporation and run-off. The longer the periods over which a knowledge of the variation of these phenomena has been obtained, the more accurately can the future supplies be predicted. This aspect of our water resources is in sharp contrast to the appraisal of many of the other natural resources. The results of the careful measurement of forest, mineral and land resources of an area provide an index of its natural wealth which usually requires only occasional repetition of the surveys to maintain and improve the accuracy of that inventory.

Well, of course, the appraisal of the water resources in a quantitative fashion, the surface water, requires the obtaining of continuous records of the flow or of the water level or both for a substantial period of time, in order that the record may be of real value for proper water use planning.

Now, also in this paper which I believe has been handed around, there is a section on regional variations in run-off and, of course, in a country the size of Canada that is a matter of particular interest, since in certain of our coastal areas the amount of run-off can be excessive. Certainly the amount of precipitation can be excessive. Whereas in some areas of the country, notably portions of southern Alberta and southern Saskatchewan, there at the present time really is not enough water available for the maximum or optimum development of the other resources, notably the land.

Mr. Patterson has given you a brief summary history on the growth of the water resources branch and I do not propose to speak on that part of his paper. I would like to draw your attention to some of the factors that are involved in the arrangement and maintenance of stream flow stations.

You will find a reference to this at page 76 of the paper that has been distributed.

As an illustration of the work involved in the operation and maintenance of the hydrometric survey, let us take the example of determination of the flow of a river. The first step is to make a reconnaissance survey of that reach of the river in the vicinity of the location where the flow information is necessary. This may be accomplished by boat, but frequently involves foot travel. On a river in its natural state, there is normally a definite relationship between the level or height of the water at any given point and the flow or amount of water passing that point. Where this relationship exists, it is possible to define it by making a series of measurements of the flow at different river levels. It is necessary, therefore, on the reconnaissance or first trip to the river, to select the best possible location for a gauge which will indicate the level or height of the river, and a cross-section of the river where accurate measurements may be made. Once these have been selected, the engineer must decide on the particular type of gauge to be built and also on the equipment for measuring the flow.

Illustration of some of the methods used on our large rivers is shown on the paper which has been distributed. Also there are illustrations of miscellaneous equipment and structures on the large piece of cardboard we have over on the wall. We will leave that there, available for anyone to look at it.

Mr. KINDT: Are these measurements made during the whole twelve months of the year?

Mr. McLEOD: Yes; not necessarily every month in every location, but it is one feature of the water resources survey which is very different from a

normal topographical survey. During the winter, field work is involved as well.

Mr. KINDT: During the winter when the ice is frozen over do you get into the problems of the flow?

Mr. McLEOD: Oh yes; very much so. As a matter of fact it is one of the more difficult problems. If you look at the top three pictures on that sheet on the wall you will see samples of winter measurement equipment. There is a measuring sled on skis which suspends the current meter. There is also a tank with a gasoline heater in order to keep the meter from freezing in travelling between the holes cut in the ice.

Mr. KINDT: At Lethbridge the tributary of the south Saskatchewan river which flows by there is often quite low during the month of January. In that respect there is a real problem there for industrial development—

Mr. McLEOD: Yes.

Mr. KINDT: —in connection with the conveying of waste material and other things. This ties into the whole question of water development in that area.

Mr. McLEOD: Yes. Another example of that, as a matter of interest, is up in northern Quebec. Our engineers attempted to measure one stream some winters ago and after getting through seven feet of ice they discovered there was no flowing water and no flowing slush. So for useful purposes the flow of that stream at this time in the winter was zero, although it is quite a good sized river in open water conditions.

Mr. KINDT: Is there information readily available on the Old Man river which flows by Lethbridge, in respect of the behaviour of that stream?

Mr. McLEOD: Yes. We have taken records on the Old Man river near Monarch for nearly twelve years now. The records for nine years are in our published records, which of course are available to most anyone. They are distributed as soon as they have been published to all the provincial agencies, libraries, universities and of course a supply is kept for sale or free distribution according to the individual or agency which requests it.

Mr. KINDT: That is fine. Thank you.

Mr. McLEOD: Now perhaps it would be useful if I covered very briefly some of the problems in planning a hydrometric survey program. The first important item is what use would be made of the information. As you know a great many uses are made of surface waters, either in the rivers, natural channels or the natural areas of the lakes, or in artificial channels for navigation, production of hydro-electric power, irrigation, domestic water supply purposes, recreational purposes, and reduction of pollution or the disposal of pollution materials by dilution, provided of course the rivers are large enough to accept it. I might add this latter use is becoming less and less helpful to the larger communities in Canada. I do not propose to say anything more about this aspect because it is really not my business. I just make that observation.

Of course those of us who have been around Ottawa have heard the local sounds of pain in reference to the fact that we are going to be involved in a large sewage disposal system in this area in the next few years, despite the size of the Ottawa river. You will perhaps draw some sort of a picture from that situation.

I think I might mention a typical example of water use planning which occurs when a reservoir is proposed for a town water or municipal water supply. Foremost among the requirements of the design engineer would be the need for a long continuous record of stream flow to provide the data for determination of the size of the reservoir. Is its capacity greater than

the stream flow potential? Is it expected that the reservoir will be empty once, or perhaps twice in the next fifty years? What size of spillway should be provided for the dam to ensure that the structure will not fail under a severe flood and cause damage and loss of life? These are but a few of the questions for which adequate stream flow records would provide the answers. In addition the efficiency of the regulation reservoir is dependent upon knowledge of the duration of low flows. In other words in most streams in Canada there are periods of low flow and periods of high flow. The periods of high flow really are not too serious in the case of water supply provided the structures are adequate to pass any high water which may occur. But the periods of low flow may be very significant in determining just how much use can be made of the water supply available in the reservoir.

Now Mr. Chairman, I think in a very sketchy manner I have covered sufficient of the organization of the branch. I attempted to define, at least in some fashion, some of the reasons for carrying out hydrometric survey operations. With that I would suggest at this moment I close. If there are any questions I will attempt to answer them.

The CHAIRMAN: Thank you very much.

Mr. SLOGAN: I was wondering if you had knowledge of any difference in the volume of water crossing the border at Emerson since the United States undertook to construct some reservoirs of their own on the Roseau river.

Mr. MCLEOD: I could not say there has been any significant difference. However that answer I have just given you is in a sense based on ignorance, because I have not scrutinized in detail recent records of the Red river.

Mr. SLOGAN: I have one more question. Over the years have you noticed any significant difference in the levels of flow of water in various streams due to the melting of the polar ice cap, and the difference in the earth's tilt?

Mr. MCLEOD: I do not think there is any significant difference covering the period for which we have records. I might add that as one of the side-lines, if you like, in connection with the hydrometric survey operations, the branch does do a limited amount of glacier survey investigation in the rockies, the coastal range, in Alberta, and in British Columbia for the particular purpose you have just mentioned.

The general pattern at the present time in these glaciers seems to be one of recession. But the differences in the stream flows do not appear to be particularly significant.

Also in connection with your question I would like to point out that the stream flow and water level conditions appear to travel or conform to some sort of cycles; that is, there will be periods of perhaps several years when flows are higher than normal, and then a period of several years when they are lower than normal.

As you know even better than I do, the period of the 1930's was particularly obviously a low flow period virtually over the whole of the prairie provinces, in contrast to the period of the 1950's which was probably a period of high supply or high water period, as was evidenced in the Red River floods of 1950, and the Saskatchewan river floods of 1953 and, with better than average supply of water on the whole throughout those years.

Mr. AIKEN: My question was very much along the same lines, Mr. McLeod, but I was going to ask you if, from the records available, patterns have been established on water flows, and if so, during what length of cycle? That is, per 20 year cycle and so on? Are there any records in that regard?

Mr. MCLEOD: I do not think we have enough information to estimate the length of cycle in any particular area. It is only that we have recognized, as I say, in the 1930's, and in central Canada, and right before this, a very low

cycle, and that in the 1950's there seems to be a period of recovery and running into a high cycle; and there have been one or two signs in the last year or two that perhaps the top of the cycle with respect to prairie waters has been reached again and we may be on the way down, but I do not know.

Mr. KINDT: Mr. McLeod, does your hydrometric work record the various stages during the flood periods?

Mr. McLEOD: Anywhere we have the equipment and the gauges, yes. On some occasions of extreme flood, when our equipment has been lost, nevertheless we have been able to pick up peak flood levels by means of field surveys, high water marks and so on.

Mr. PATTERSON: Mr. Chairman, Mr. McLeod I think has covered the points raised in the questions fairly well with the exception of one point which was directed toward the effect of earth tilt on flows, which I believe was raised by Mr. Slogan.

What happens with respect to earth tilt and its effect on waters such as those of lake Ontario is as follows: we recognize this tilt as going on. The outlet of the lake is rising relative to the Grimsby end or the west end of the lake, but it does not show any effect on the flow of the river downstream, due to the fact that the water will follow up. There will be some slight delay of course, but the water will rise, and it will still spill off in the same quantities as previously. The only time when it might reach a stage where it did show an effect would be if the outlet rose to a point when the water would find some other outlet and run out another way.

Mr. FLEMING (*Okanagan-Revelstoke*): There is one point I would like to have clarified in greater detail. In the Columbia basin where you have conducted very extensive surveys over the past few years, and at the same time where the water resources branch have been conducting surveys, as well as the British Columbia provincial water branch and so on, may I ask what relationship there is between these different surveys? What are their separate fields, and what is the point of coordination between the various types of federal and provincial surveys in matters of that kind?

Mr. McLEOD: As Mr. Patterson mentioned in his outline, the province of British Columbia in common with many others has requested the government of Canada to maintain and operate a stream flow hydrometric survey for them; and this is of course carried out. It includes work on the Columbia river as well as on many other rivers in British Columbia.

The province of British Columbia itself does work through its water rights branch. The water rights branch is the body which issues water licences for the use of water in the province under the British Columbia Water Act. That branch also provides some service to small communities when they have problems of water supply and so on. And it may provide engineering advice to them as well, but that is purely, of course, an internal matter.

In regard to the Columbia river surveys, this department—I think I might say—handled virtually the entire survey of the Canadian portion of the Columbia with, of course, assistance from the Department of Mines and Technical Surveys, the Department of Public Works, and so on. Those federal departments and the province of British Columbia participated in the survey of the Columbia river basin, particularly as far as the field work was concerned, and they participated quite actively in the studies that were made of the material obtained from the field investigation, which led to the Columbia river engineering board reports, and of course to subsequent information that has been obtained for the use of the two governments at the present time.

Mr. FLEMING (*Okanagan-Revelstoke*): Is it apparent in that basin that the recession of the glaciers is quite marked and has been very rapid in the last couple of years? And are other glaciers receding at the same rate?

Mr. McLEOD: I would say that the Illecillewaet has receded somewhat more rapidly than the Kokanee in the southern area, or the Athabaska glacier and the Columbia ice fields.

Mr. FLEMING (*Okanagan-Revelstoke*): There has been no cycle effect on it as a whole?

Mr. McLEOD: I would say no. Of course, one of our problems in connection with recession of glaciers has been that our surveys have, of necessity, been rather limited, and recession figures from year to year are not always too significant unless you have details of the configuration of the glacier at the same time.

As an illustration of what I mean I am going to refer to the Franklin glacier out on the west coast of British Columbia near Mount Waddington. On the Franklin glacier there was a marked recession over a period of three years some time back, but it was discovered that what had happened was that probably for some time before that melting had occurred in the lower section of the glacier such as to make a series of caves, as it were, without the edge, or the end, of the glacier showing this effect. Finally the whole thing collapsed and the glacier moved back quite a long distance over what was relatively a short period. But it was shown that the melting which caused this cavitation must have taken quite a number of years to occur, and that condition had to be taken into account in looking at the individual annual or bi-annual recession figures.

Mr. FLEMING (*Okanagan-Revelstoke*): I see. It was not something that just happened?

Mr. McLEOD: That is right.

Mr. FLEMING (*Okanagan-Revelstoke*): It had been in the process of happening for a long time?

Mr. McLEOD: Yes.

Mr. FLEMING (*Okanagan-Revelstoke*): With this measurement of places, this could happen many times over, I suppose?

Mr. McLEOD: Possibly so. We have undertaken this past year a detailed survey of the Athabaska glacier in the Columbia ice fields, and we believe that if we repeat the techniques which were utilized this year, in about three years' time we should then be able to make a direct comparison of the results of 1959 and, say, 1962 or 1963 and obtain from them fairly good data on the amount of volumetric recession, or increase, of the glacier.

Mr. KORCHINSKI: Mr. McLeod, you mentioned that you had 157 gauging stations in Saskatchewan, and you also made reference to the fact that you make a study of the capacity of the river at a certain point.

These gauging stations vary from river to river, I suppose; but if a community somewhere in between two gauging stations required information for a water reservoir, would your department cooperate in giving them this information or obtaining this information for them?

Mr. McLEOD: Normally speaking, the community would first get in touch with its provincial water rights division, or branch—or equivalent. The reason I say "equivalent" there is that in the different provinces the provincial water agencies have somewhat different names. Having done so, the provincial water rights division people would approach our organization, if they considered that additional stream flow data were necessary to answer the particular question, or problem.

The CHAIRMAN: Mr. McLeod, I would like to ask a question. Do you find that communities and industries in provinces take into full account the information that is available to them in their planning of the use of water? I am thinking particularly of some of the areas where there is a considerable shortage of water, as on the prairies. Has the use of that water been properly planned, or is it being done on a hit-and-miss basis?

Mr. McLEOD: That is a pretty large question, Mr. Chairman.

The CHAIRMAN: Well, you must have some opinion.

Mr. McLEOD: I think the answer varies all the way from full consideration of all available information by some agencies, to perhaps not enough consideration or not enough effort to find out what is available by other agencies.

I do not believe that I could offer a much more concrete answer than that. Mr. Côté, would you like to say something on that?

Mr. E. A. CÔTÉ (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): I should imagine, Mr. Chairman, that those communities that hire engineers to do some work for them, either for water supply or any other purpose, would find that those engineers would consult the flow data records of the department, and would consult, in the case of ground water, the ground water records of the Department of Mines and Technical Surveys.

The CHAIRMAN: I was thinking of this, that it could be such that there was no over-all plan for the use of the water in a basin or an area, and that final development could be jeopardized by, not necessarily ill-planning, but by not giving consideration to the over-all use in those areas.

We will be coming into this subject later on. This applies particularly as regards the prairie provinces, I imagine, where there is probably the biggest shortage of water in all of Canada.

Mr. T. M. PATTERSON (*Director, Water Resources Branch*): In answer to your question, Mr. Chairman, I think I will go further. I think that there is room for improved cooperation in the planning and use of the water resources of a large river basin such as the western rivers to which you are referring, particularly the Saskatchewan river, where it flows through different jurisdictions, three provinces, and each province has its own particular needs to look after. I think there could be improved study and planning of a river of that nature.

The CHAIRMAN: You do not feel that there is quite enough coordination yet in the planning of these things?

Mr. PATTERSON: The planning has not gone far enough yet, I would say.

Mr. McLEOD: I think perhaps, Mr. Chairman, I could just say this. I do not know if all of you gentlemen can see this map. It is of the three prairie provinces and northwestern Ontario. The Nelson river drainage basin, of which the Saskatchewan river forms a large part, consists, as you can see, of virtually the southern half of Alberta, at least the southern half of Saskatchewan, with the exception of a slight strip which flows to the Missouri, at least half of the province of Manitoba, plus a surprising amount of northwestern Ontario.

That is probably our best example of a river system which covers parts of four provinces, where in parts the area is short of water and in other parts it has good supplies, and in which, therefore, the downstream section of the river in Manitoba can be affected by something done out in Alberta or something done in Ontario.

Mr. PAYNE: Mr. Chairman, would it be in order for me to ask the witness this question. Have you done extensive studies in the immediate vicinity of what is known as the Rocky Mountain trench as to the potential storages available in that area, or not?

Mr. McLEOD: In the Peace river section of the Rocky Mountain trench?

Mr. PAYNE: Yes.

Mr. McLEOD: Our office has not done extensive studies in there, no. The information which it is believed the company interested in development there has obtained is not yet available to federal departments.

Mr. PAYNE: Has the industry interested in development of the area undertaken tests of sufficient time and sufficient intensity to ascertain what reserves might probably be expected for reservoir storage on the Peace?

Mr. McLEOD: First, in so far as records of the flow on the Peace river are concerned, this branch has had stations in British Columbia for about 15 years now. It was recognized quite a long time ago that sooner or later someone would require information on Peace river flows, although when the gauging station program there was initiated in 1945 it was not known, of course, who it might be, or when the information might be required.

Likewise, in Alberta there are, I might say, broken records of the flow of the Peace river available at Peace River, and some, I believe, at one other station, of which I do not recall the name.

As far as the reserves or lands, and so forth, are concerned, which might be required for the creation of the reservoir which, we understand, is proposed by this company, that, of course, is essentially a matter between the company and the provincial government.

Mr. PAYNE: Oh yes.

Mr. McLEOD: Because there are no federal lands in that whole region, so far as I know.

Mr. PAYNE: The studies in the Peace river area—the flows you have taken of the Peace, and in that general area—are they, in any way, comparable to those you have undertaken in the Columbia basin?

Mr. McLEOD: No, nothing like as extensive.

Mr. PAYNE: What would be the comparative situation between these two?

Mr. McLEOD: Offhand, I would estimate that we have perhaps 20 key stations in the Columbia river basin in Canada, which are on the main stem and tributaries of the Columbia, including the Okanagan, the Similkameen, Kootenay, Kettle and Flathead—and, of course, the main Columbia.

Mr. PAYNE: They are all tributaries?

Mr. McLEOD: Yes.

Mr. PAYNE: They have been functioning for what period?

Mr. McLEOD: The oldest since 1902, and there are at least—

Mr. PAYNE: And those at flow stations?

Mr. McLEOD: —at least ten of them have been functioning for 40 years or more.

Mr. PAYNE: Those stations test what?

Mr. McLEOD: They give the actual flow of water passing the point at which the station is located, and usually also they give the water level.

Mr. PAYNE: In the area north of Prince George, and what is known as the Rocky Mountain trench, what studies and undertakings have you gone into relative to the flow in that area?

Mr. McLEOD: Very briefly, as you know, the Peace river system in British Columbia comprises the Finlay and Parsnip rivers, which join at Finlay Forks. The Finlay flows southward and slightly eastward, and the Parsnip river flows northward to their junction at Finlay Forks, and then generally eastward

through and into Alberta. The branch has had records obtained at two locations on the Peace river in British Columbia—at Taylor, which is near Fort St. John, since 1945, I think, and at Hudson Hope, where there is a period of broken record. There were a few years of partial records, between 1918 and 1922, but there has been a station there continuously since 1949.

Mr. PAYNE: That is Waterton?

Mr. McLEOD: That is Hudson Hope. There has been one on the Peace river, near Fort St. John, continuously since 1945.

In addition, there have been miscellaneous discharge measurements made on the Finlay river and on the Parsnip river. There are also fairly long-term records available of the Nation river, which is a tributary of the Parsnip. Those records, I would say, have enabled the company to assess what water it can get into this reservoir, since the location of the dam proposed by the company is very close to the gauging station located at Hudson Hope.

Mr. PAYNE: Is it the experience of the branch that companies of this nature, envisaging tremendous capital developments, formulate their plans on information such as they now have available; or is it normal to expect them to further extend their information?

Mr. McLEOD: First, I think you must recognize the company, in proposing a development such as the Peace river development, must know what is the water supply to this major reservoir that it might use for power generation purposes. Secondly, they must know what effect the reservoir itself will have on the distribution of the natural flow over the full period of a year or over several years. That is simply because their reservoir will be so large it will provide what we would say is complete regulation of the river at the site of the power plant.

Then, of course, the company must have detailed information—or should have, at least—of the foundation conditions for a major structure of that kind. That is something which certainly is not our branch's business at all.

Mr. PAYNE: I appreciate that, but what I am getting at is what happens when you run into a large public corporation, be it in Ontario or Canada. We will take, for instance, the Ghost river development of Calgary. Was it your experience, within the branch, that the Calgary Power Company did, in fact, look at records for some years from your branch before they laid plans?

Mr. McLEOD: Yes. While the developments there, on the Ghost river, started at a very early period, as you know, the company has been most interested in every bit of stream flow and water level information that could be provided, and it has, in fact, cooperated quite substantially in helping us to get information.

Mr. PAYNE: Is this a pattern you find elsewhere in Canada with respect to developments undertaken by large bodies—say, those undertaken by the Ontario Hydro or the Manitoba Hydro?

Mr. McLEOD: Yes.

Mr. PAYNE: They are not looking for sketchy information: they want a great deal of detailed background?

Mr. McLEOD: That is right.

Mr. PAYNE: Do you feel you have that type of information to provide anyone in the area of the Rocky Mountain trench at this time, or not?

Mr. McLEOD: No. For a good many parts of Canada we do not have sufficient information. If I may say so, I think it could be boiled down to two things—it is the old story of government work, funds and personnel.

Mr. PATTERSON: I think any corporation or company that is interested in initiating a power development at any point has to take into account the period

of record of flow they have available to them. It is their risk. They may take a short period of record and decide to go ahead with the development. Then they might find, after operating for a few years, the period of record upon which they based their studies was a period of high flow, above average flow, and they are not actually getting that amount of water. But the urgency to develop at the time was such that they did not delay the decision to go ahead, and they may not get the return they expect in later years, or they may get a greater return.

Mr. PAYNE: The normal experience of the branch is that a corporation does look for a reasonable period of chronological history and records, to some extent, before entering upon decisions?

Mr. PATTERSON: That is right. We maintain that until you have at least ten years of record you are working on pretty sketchy information.

Mr. PAYNE: You are speaking of ten years of records, which are fairly conclusive? They cover the potential within that proposed area of development? It is not just a hit-and-miss station; it is an extensive study in a ten-year period?

Mr. CÔTÉ: Mr. Chairman, I think I should say at this point that the branch likes to see a long period of records. That is quite so, but to answer Mr. Payne's specific question regarding the Ghost river, in the book here which was referred to—The Arctic and Western Hudson Bay Branch Surveys, water supply of Canada—regarding the Ghost river, near Cochrane, there the period of record was from 1911 to 1920, which is nine years, and then from December, 1928 to date. As I recall it, they built the Ghost river dam in the late 1920's or early 30's, after about ten years.

Mr. PAYNE: It was completed around 1932, I believe.

Mr. CÔTÉ: The decision was taken before then, so the period of record—the broken period of record—was something in the order of ten years.

Mr. PAYNE: You went back to 1911?

Mr. CÔTÉ: 1911 to 1920, a broken period of record; no record from 1920 to 1928; then from 1928 to the date of construction in 1930-32; and then to date.

Mr. PAYNE: You have covered quite a bracket of years in the study?

Mr. CÔTÉ: A matter of nine years' continuous record, and from 1928 to the date of construction, another three or four years.

Mr. PAYNE: But you regard that as a reasonably short period, this bracket of almost 18 years, with nine years' continuous study?

Mr. CÔTÉ: Mr. Chairman, I think that if any engineer had his say, he would like a very long period, as mentioned earlier by Mr. McLeod, because of the variations which may be century variations or variations within a millennium.

Mr. PAYNE: Have you, within the last 18 months, been called upon extensively for the brief period of record you have in this area, by a company anticipating development in the Rocky Mountain trench? Those limited records you have made available to them?

Mr. MCLEOD: Of course, in the first place, all of the records we have up to, perhaps, three years ago were already in publication, and the company had copies of those immediately available.

Mr. PAYNE: Have you had reciprocal information from them, to any extent at all?

Mr. MCLEOD: No.

Mr. PAYNE: None?

Mr. MCLEOD: No.

Mr. KORCHINSKI: Mr. McLeod mentioned there are 1268 gauging stations throughout Canada.

Mr. McLEOD: That is our figure at March 31, 1959.

Mr. KORCHINSKI: In your presentation to the Royal Society you also state that you have some 500 part-time employees engaged in reading these gauges?

Mr. McLEOD: Yes.

Mr. KORCHINSKI: The question that comes to my mind is, why do you require 700—I should not say "more employees," but you require far more than 500 part-time observers? Is it because of the fact these gauges are so complicated, or because of the remoteness?

Mr. McLEOD: First, with regard to the 1200 gauging stations, that includes a number of gauges—quite a number now—which are, as we term them, automatic or self-recording. Many of those, particularly when located in remote areas, are serviced by our personnel when they visit them, sometimes monthly or at two-month intervals. In a good many of our locations, whether we wanted to or not, we could not get part-time employees anyway.

Secondly, the part-time employees are used to read the manual types of gauge, either daily or on some other basis that may be determined, depending on the need for information. Customarily it is daily. That consists usually of perhaps three minutes work for the employee at the location, plus whatever time it takes him to get to the river from his place of residence or place of work. We have about 500 places where we do require and do have these gauge readers employed strictly on a part-time basis. We have something like 250 water stage recorders installed now, and many of them require no paid observer on a part-time basis, because they are serviced by our people.

In addition, in some locations one part-time gauge reader may read two or three gauges along a river, depending on how they are located, and so forth. For example, for many years we took a lot of gauge observations on the west arm of Kootenay lake, investigating problems of out-flows from Kootenay lake. I can recall that one gauge reader read something like 8 or 9 gauges for us, because he made a trip down on his boat and read each one as he went. However we do not need very many additional gauge readers; that is no particular problem. What we need more of, and what we will continue to need more of are the more expensive things—the automatic recording instruments and the appropriate housing of them—for these remote areas where there is not anybody living to provide a part-time gauge reader service.

Another item which is growing very rapidly in our estimates, and which is going to continue to grow rapidly, is charges for chartered aircraft, because we are getting more into remote places now, particularly in territories where this is the only way of getting in and out.

Mr. KORCHINSKI: What determines whether you construct an automatic station or one where you require a gauge reader? I suppose that is governed by cost in a lot of instances?

Mr. McLEOD: Yes, partly cost; but it is also in part the location itself. For example—Mr. Payne may know this—up on the Unuk river—which is part of the Stikine river system which flows in the northwestern section of British Columbia and enters the Pacific down through the Alaska panhandle—we have a gauge station in there which must be self-recording because there is not anybody who lives within 50 miles of the place.

Mr. KORCHINSKI: What variation is there in cost between one of the gauging stations, where you require a gauge reader, and an automatic one?

Mr. McLEOD: The cost of just a manual installation, I think it would be fair to say, can be as low as $50, depending, again, on the configuration

of the banks of the river and the type of readings required, and so forth. The cost of a recording station varies considerably. If it is for a permanent lay-out, some long-term job, the cost may run up to $20,000 or $25,000, depending on what is required, and also depending on the conditions encountered.

I do not know whether these pictures are visible to you, but here are three pictures of the water stage recorder well and shelter on the Fraser river at Mission. The original cost was about $9,000. It had to have about $3,500 to $4,000 worth of work done after the 1948 flood. This was literally hanging in the water, and this is it as it was rebuilt. That is a typical example. There is one pretty low down here on the Fraser river at Hope, which cost about $7,500.

One of the things that dictates the cost, of course, is the money available. Another thing that dictates the type of gauge is the location and also the type of river or lake. For example, I think it is quite fair to say that on some of the lakes you could actually use manual gauges, provided observers were available, because the day-to-day change at some lakes is very small. On the other hand, such rivers as Capilano creek—

Mr. PAYNE: "River" please.

Mr. McLEOD: On Capilano creek it has changed 12 feet in 15 hours. No manual observer could hope to catch those changes, which are essential to an accurate record, and can be provided by the water stage recorder.

Mr. KORCHINSKI: You mentioned a lot are permanent. Are there very many constructed on a temporary basis?

Mr. McLEOD: In several of the provinces requests are received from the provincial authorities for records on some of the smaller streams—for irrigation purposes, for example. They may want only a limited period of record, perhaps to establish roughly the size of the stream. These are very small streams, down around two, five or ten cubic feet per second. They may want a record only during the low-water season, during the latter part of the summer. In those cases usually the installation is kept at as low a cost as possible, of course, and it is of a temperorary nature, because we may know in advance the particular agency requesting the record only wants two or three summers' records. Therefore, we would not go into the expenditure involved in a more permanent station. On the other hand, the Red River at Emerson, or the Assiniboine river near Headingley, or the Fraser river at Mission, or the St. Lawrence river at Ville de la Salle—for these we have every indication we want the records for a longer period of time, and for as long as possibly 50 years or more. Therefore, it is only prudent we decide in those cases to establish more permanent types of structures.

Mr. PAYNE: To return to the Rocky mountain trench and Peace river, has the branch been called upon by the province of British Columbia, any agency or company, for an accelerated program, indicating their requirements and their need for more information?

Mr. McLEOD: As far as I am aware, not by the province of British Columbia. The consultant firm for the company has requested some additional information downstream on the Peace and Athabaska rivers in Alberta.

Mr. PAYNE: Have the developing engineers concerned indicated in any way that they are working with insufficient informatoin at the present time?

Mr. McLEOD: No, not to my knowledge.

The CHAIRMAN: I have a question, Mr. McLeod. What jurisdiction has the federal government over a project such as proposed on the Peace? It is bound, for certain periods anyway, to have some effect downstream both in Alberta

and on the Mackenzie system. Now, as I understand it, the federal government has no authority over the use of that water upstream; but what steps can they take to ensure that proper flows will be left downstream during the filling of a reservoir?

Mr. CÔTÉ: Mr. Chairman, I would like to take that question, if I may.

The question of jurisdiction of the federal and provincial governments is an extremely complicated one, and I do not think the committee would expect Mr. McLeod or myself to be able to give a clear constitutional answer to that subject. Nevertheless, in an attempt to outline some of the perimeter of the problem, the ownership of the water, as it is within the province, seems to be that of a province or territory, as the case may be, while the water is within the boundaries.

The federal government has certain direct responsibilities, which are legislative responsibilities under the British North America Act, for certain uses of water. In regard, say, to the Peace river the federal government's responsibility is a legislative responsibility concerning the navigational use of that water, or concerning the fisheries within those waters.

Mr. PAYNE: What about the situation of interprovincial interests?

Mr. CÔTÉ: Well, Mr. Payne, I think you have put your finger on the problem which was mentioned earlier by Mr. Patterson and, indeed, was mentioned by my minister in his opening statement.

There is a problem between the provinces as to the uses of these waters in one province or in the other—the possible future incapability of use in one province in regard to the other. This is the sort of problem which Mr. Hamilton has indicated may be solved by cooperative action between the provinces.

Mr. MARTEL: Mr. Chairman, I am interested in the question of gauging and flow measuring stations from the lake downstream in the St. Lawrence. I understand from your lecture to the Royal Society of Canada that this has been done to record the levels for navigation on the Great Lakes and the St. Lawrence applying since 1860. I would like to know from your knowledge or as a result of these measurements if the water level of the Great Lakes has increased very much in ten years or twenty years. I might tell you why I want to have that answer. I may tell you that last year we have heard a lot about the diversion of waters from Lake Michigan to the Mississippi basin in southwestern United States, and I want to know what effect that could have on the original level of the lakes.

Mr. MCLEOD: I think Mr. Patterson is better equipped than I to answer that question.

Mr. PATTERSON: Mr. Martel, as you have indicated, we have records since 1860 on the Great Lakes and naturally, or in nature, the lakes vary from year to year and from so-called cycle to cycle. Over that period of what is now a hundred years the lowest recorded levels on the lakes occurred in the thirties, around 1934 and 1935, and the highest recorded levels occurred in the fifties, in 1952. But there were high levels away back in the 1870's.

With regard to the effect that the Chicago diversion has on the Great Lakes, it does have an effect of course. Diversion now is about 3,200 second feet and the natural rate of flow from the lakes, if you consider all the lakes, runs around 20,000 second feet per foot range and varies in the different lakes—17,000, 18,000, 20,000; but, say, 20,000. So that if you take out 3,000 second feet from that system you lower the lakes by the 3,000 over 20,000 times 12 or approximately two inches.

Mr. MARTEL: Would that not endanger navigation in the seaway?

Mr. PATTERSON: It could have an effect on navigation. It could have an effect in any harbour if the water in the harbour is two inches lower than it otherwise would have been. If it is at a low water period it might be that a boat could not get into a particular harbour, if it is loaded fully. But ordinarily there is, as you know, a great variation just from month to month, and the boats load according to the depth that they know they are going to get in the harbour they are proceeding to.

Mr. MCGREGOR: How much would be the extreme variation?

Mr. PATTERSON: It varies in different lakes. The extreme variation in lake Ontario in nature was about six feet, something like that.

Mr. MCGREGOR: What about lake Superior?

Mr. PATTERSON: Lake Superior is a much larger body of water, and the range there is not as great. On top of this variation on the subject of the level of the lake of course you have the storm effect, where high winds will blow water into a certain area and will create a higher level in that particular area. But the average level of lake Superior varies about five feet, I would think—four to five feet.

Mr. SLOGAN: I was just wondering if Mr. Patterson or Mr. McLeod could tell us whether they have noticed any difference in the Red that flows from south to north, or the Assiniboine that flows from west to east and a river that would, we will say, flow from north to south.

Mr. MCLEOD: I don't think that the difference in direction of flow is particularly significant. All questions with regard to flows and floods and changes in the Red or Assiniboine are related, of course, directly to the climatic conditions preceding the period of the high flow in question, and they are related, too, to the type of land through which the rivers make their way. Also they are related to the general topography. For instance, as you know, Mr. Slogan, high flow on the Red river results in virtually a lake in the area from Emerson northward. The gradient of the river is very gentle and the river itself is quite wide in proportion to the amount of water it carries normally. I think those features of topography and of climatic conditions outweigh normally at least any difference with respect to the actual directions of the rivers.

Mr. SLOGAN: The reason I asked that was I thought—well, for instance, the Red river melts down south first and you get the flood waters coming up before the breakup in the northern area and you get your ice jams; whereas if the flow were in the opposite direction you would get a gradual drainage and would not have the ice jams to put up with.

Mr. MCLEOD: It is conceivable there might be some difference due to the difference in the times of melting, although I do not think they are very significant as far as the Red and Assiniboine are concerned. Unfortunately, if one is going to be high the other is going to be high at just about the same time usually.

The question of the ice jams, of course—well, again I do not think there is too much difference there, because if we take another river such as the St. Lawrence, ice jams occur that affect places like Montreal harbour, which from the point of view of latitude is quite a bit south of much of the upper watershed consisting of the Great Lakes; and I do not really think there is any particular relationship to the direction in which the river flows, other than perhaps the slight variation you have mentioned in so far as the break-up may come a little earlier on the Red, with the water coming from the south, than on the Assiniboine with the water coming from the west. I do not know if I have answered your question.

Mr. MARTEL: I have just one other question. I wonder if it is proper to ask it of you, or perhaps to ask it of the forestry branch. My question is what

influence the heavy cutting of forest in local areas, particularly since the war, in a number of areas has had on the regular flow of waters. I mean, broadly speaking, I do not want a detailed answer.

Mr. McLeod: Well, broadly speaking, Mr. Martel, the forest cover of a river drainage area should tend to slow the flow, particularly in rising stages. The shade provided by forest cover, for instance, will operate to hold snow in the spring and will reduce its rate of melting. The other feature is, too, that the clearing of land unless it is done carefully tends to allow the land to erode and causes a certain amount of sedimentation in water in the river etc.

Mr. Martel: We must have read some reports that there is too heavy forest cutting in certain areas, according to some experts. That is why I felt it may be good to know if this has an influence. It has, of course, an influence on the flow of water but the degree, I do not know.

Mr. McLeod: I think in general terms one might say that the change in the vegetal cover of the drainage area of a river does, of course, have an effect upon the regimen, if you like, of the flow. That factor is probably more noticeable in a small stream of a limited drainage area than it is on a large river where you might have quite a variety of land covers ranging from forest to cultivation, etc. I do not think there is any really quantitative answer to your question as yet. I do not think it would be remiss to mention that the eastern rockies forest conservation board in this aspect of river flow and water supply is undertaking, in conjunction with officers from our own branch and several other agencies of government, further studies on this matter. It will not be one which is subject to quick answer because it will take a number of years of measurement to provide enough base data to enable any conclusions to be drawn as to the differences.

Mr. Martel: Are there any other similar programs in any parts of other provinces?

Mr. McLeod: Not with which we are connected in any event.

The Chairman: We do have a heading here for discussion in respect of conservation later on. Perhaps we might pursue the matter at that time.

Mr. Mitchell: I do not know whether or not this is a proper place to present this, although it is under the water resources branch. I am referring to the Harricanaw river project. As the water resources branch will probably be with us at our next meeting I will bring this up at that time.

The Chairman: We will endeavour to cover various regional problems later on. They will probably be more appropriately taken up at that time.

Mr. Mitchell: The engineer in Sudbury is well known to me. We have been talking about this for some months. I noticed by today's *Globe and Mail* that he has presented his brief to the Minister of Water Resources in the province of Ontario. I have considerable information on this, including a copy of a letter to the hon. Mr. Hamilton which Mr. Kierans has written. I assure you you may think he had been dropped on his head when he was young, and perhaps me as well, in presenting this, but I assure you that, although it may seem fantastic, it has a certain amount of merit. I would like to present this to the committee at the next meeting.

Mr. Martel: That is of interest to me because the Harricanaw river flows in my riding. I do not know of the project except what I read in the paper.

Mr. McLeod: Is the newspaper reference a recent one?

Mr. Martel: There was one this morning.

Mr. Mitchell: I have here a copy of the original map supplied by Mr. Kierans to me and also the newspaper item which is dated January 23.

Mr. McLeod: We have that.

The CHAIRMAN: Gentlemen, I am sure we have all enjoyed hearing from the witnesses.

Mr. SLOGAN: May I interrupt, Mr. Chairman. Mr. McLeod, I am wondering whether you have anything to do in conjunction with the Department of National Health and Welfare in respect of gathering samples of water for testing for radiation.

Mr. McLEOD: No, we do not.

The CHAIRMAN: We will not be meeting tomorrow because of the fact that there is a shortage of reporters and there are so many committee meetings going on. Our next meeting will be on Friday, April 1 at 9 a.m.

Mr. MARTEL: Instead of tomorrow?

The CHAIRMAN: Yes. At that time we will have with us Mr. McTaggart-Cowan, the director of the meteorological services of the Department of Transport who will give us some information regarding the services that branch provides in relation to assessment of water resources and problems.

There will be a meeting on Monday, probably to pursue part of our previously outlined agenda.

On April 4 we will have Mr. Fox who is a United States authority on water problems and I believe particularly in respect of the western states, the problems of which are very similar to many of our prairie problems. Perhaps Mr. Cote would tell us a bit about Mr. Fox's background.

Mr. CÔTÉ: Mr. Chairman, Mr. Fox is connected with resources for the future, a non profit organization of the United States, which has studied very extensively questions about natural resources in the United States. I gather that he has a good deal of information on the general subject of water resources and the future demand on water resources in the United States, which might be of interest to this committee, particularly as regards its possible impact on Canada.

The only point is that I think he will be here on April 5, which is a Tuesday.

The CHAIRMAN: Thank you. At the last meeting I mentioned that we hoped to have General McNaughton appear before the committee, but General McNaughton will not be available until early in May, because of the pressure of his other responsibilities.

I think that is all for today.

—The committee adjourned.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 3



FRIDAY, APRIL 1, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESSES:

Mr. P. D. McTaggart-Cowan, Director, Meteorological Branch, Department of Transport; and Mr. E. A. Cote, Assistant Deputy Minister, Department of Northern Affairs and National Resources.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22871-8—1

STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

FRIDAY, April 1, 1960.
(4)

The Standing Committee on Mines, Forests and Waters met at 9.05 a.m. this day. The Chairman Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Baskin, Cadieu, Doucett, Dumas, Fleming (*Okanagan-Revelstoke*), Gundlock, Hicks, Korchinski, Martel McFarlane, McQuillan, Payne, Robichaud, Simpson, Slogan, Stearns and Woolliams—17.

*In attendance: From the Department of Transport:* Mr. P. D. McTaggart-Cowan, Director, Meteorological Branch. *From the Department of Northern Affairs and National Resources:* Mr. E. A. Côté, Assistant Deputy Minister; Mr. J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Mr. Côté, Assistant Deputy Minister of Northern Affairs and National Resources read into the record a definition of *navigable waters* as interpreted by the Department of Public Works. A statement also was made regarding *soil erosion* on navigable waters.

Mr. McTaggart-Cowan was introduced and he made an extensive statement regarding the studies, problems and work of the Meteorological Service. The witness supplied a number of copies of the following documents:

(1) Hydrometeorology and its applications in Ontario.
(2) Symposium on the Great Lakes, Royal Meteorological Society.
(3) Rainfall intensity—duration—frequency maps for Canada.
(4) Snow Cover Data—Eastern Canada.
(5) Hydro-Meteorology—Statement by Australian Minister of Interior.
(6) Estimating Irrigation water requirements from Meteorological data.

During his presentation Mr. McTaggart-Cowan emphasized certain points by the use of charts and maps.

The Witness tabled *one* copy of the following documents and commented thereon:

(1) Presentation made at the Symposium on the Great Lakes by J. P. Bruce and G. K. Rodgers respecting *The Water Balance of the Great Lakes System; (Identified as Exhibit No. "1")*.
(2) Report of Conference on the Management of Wetlands, Ontario Water Resources Commission; (*Identified as Exhibit No. "2"*).

At 10.30 a.m. the Committee adjourned until 11.00 a.m. Monday, April 4, 1960.

E. W. Innes,
*Acting Clerk of the Committee.*



22871-8—1½

# EVIDENCE

FRIDAY, April 1, 1960.

The CHAIRMAN: Gentlemen, we have a quorum.

As the first order of business, Mr. Côté is going to give us some information, which he has obtained from the Department of Works, in regard to a definition of "navigable waters".

Mr. E. A. CÔTÉ (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): Mr. Chairman, two meetings ago the committee asked for a definition of "navigable waters", and the federal responsibility for erosion.

We inquired from the Department of Public Works and have received the following reply from the Deputy Minister of Public Works:

> In regard to your first question, the term "navigable waters" refers to such waters in respect of which the public right of navigation exists. This right does exist in all rivers that are in fact navigable, including small streams or creeks, whether tidal or non-tidal, even if navigation by, say, canoe only is possible. A canal, being an artificial highway by water, does not come under that definition.

The second question which the committee asked was related to erosion, and this is the reply which the Deputy Minister of Public Works proposed to the question:

> The second question concerns the responsibility of the federal government with respect to navigable rivers, particularly as it affects the problem of bank erosion. In this regard, I may say that parliament approves the use of funds for protection works each year, only where damages are caused by or endanger commercial navigation or federal government structures, and for the completion of works already under way. There is, however, no statutory responsibility for the federal government to do such work.

Mr. Chairman, those are the answers which the Department of Public Works have supplied.

The CHAIRMAN: Gentlemen, we have with us this morning Mr. McTaggart-Cowan, director of the meteorological branch of the Department of Transport. Mr. McTaggart-Cowan has come from his headquarters at Toronto.

At this time I would ask Mr. McTaggart-Cowan to proceed with his presentation.

Mr. P. D. MCTAGGART-COWAN (*Director, Meteorological Branch, Department of Transport*): Thank you very much, sir.

I thought perhaps the best way of presenting the meteorological aspects of water was to first give you a very brief outline of what meteorology is, because the scope of it has changed substantially over the last 20 years; and then proceed to relate meteorology directly to the water problem.

I might say also, Mr. Chairman, that I brought with me copies of certain reprints of scientific articles to which I think the committee might wish to refer. I will make mention of them in my presentation. Also, I have single copies of other articles, of which I could not get multiple copies. If you wish, I will leave these as reference material.

The CHAIRMAN: Thank you very much. Could we have these articles distributed.

Mr. MCTAGGART-COWAN: I think the simplest way to define meteorology is that it is the scientific study of the atmosphere and, in the context with which we will deal today, it is a study of the lower 20,000 to 30,000 feet of the atmosphere which is important. In the context of the space age, of course, the atmosphere surrounds the whole of the sun. In this context then our weather and climate are themselves a basic natural resource; and it is only through the knowledge and understanding of the water and the climate that the management of the other natural resources such as water, forests and agriculture can be progressed intelligently and managed effectively.

In regard to this concept of water and climate as a basic natural resource, the thought has been creeping over the world, largely in the post-war years, and to a considerable extent brought about by the realization that the world has a real water shortage over most of its area, that the effective management of this condition depends, to some extent, on our knowledge of the weather and climate of the area concerned.

Now, naturally I will confine my remarks today, to the subject on which I am competent to speak—meteorology. I would not want for a moment to leave the impression that the related disciplines in this water problem are less important simply because I did not mention them. However, I hope, as I go along, that you will see that the meteorological aspect is really a science service that has to be provided to the hydrologist, the hydraulic engineers, agronomers, forest scientists, and so on, so that they can play their part in the over-all management of water. And while, perhaps, the knowledge we have is a key part of the whole machinery, it is nothing more than just a cog in the whole complex problem.

Meteorological activities of importance to this problem fall into four main categories.

The first is the field of measurement; and in any of the natural resources the understanding of the problem depends on getting out and measuring the physical parameters—the variables, that define the field. The rest of your work is only as effective as those measurements are accurate. However, I will come back to that later.

The second role of the meteorological service is perhaps the most widely known, and that is the forecasting role. To most people of the world this conjures up in their minds that this concerns the forecasting of civilian or military activity but, at the present time, that is only one part of the forecasting or predicting role of meteorology, and it enters, equally importantly, in the water management complex as it does to land, water and air transportation, as it does to forest management, and almost every activity. This is consequent on the increase of our ability to predict meteorological phenomena.

The third facet we call climatology, which use the same basic measurements which are used in forecasting; and we process them in a statistical manner to define the climate of the area or to determine probabilities of certain events occurring, or the probability of certain maximum events recurring again in "X" number of years. The field of climatology depends on the amassing not of one or two years of records but of 30, 50 or 100 years, in order to draw a sound conclusion.

Finally, there is the field of research, wherein we hope to plug gaps —and there are many—in our present knowledge. I will return to this again in connection with the water problem, where there are real gaps in our knowledge. So perhaps that, sir, gives you a capsule picture of the field in which we operate.

From the standpoint of our capability naturally with the development of Canada over the last hundred years the primary initial requirement was

to ensure, in so far as the meteorological part was concerned, safe and efficient transportation. When you have such a small population widely scattered, transportation is perhaps the key role. Certainly in the post-war period, with the rapid growth in population, water and natural resources are being used more intensely, and the emphasis in meteorological service is rapidly balanced out to where the demands of natural resources have nearly equalled the demands for transportation and the like.

Then, if I can go from that to directly correlating meteorology with water resources I would like to refer to the first chart I have here. I apologize for the size of the print. The artist had to make a guess as to which committee room you would be meeting in, and I think he guessed a little wrong.

The principal thing I want to demonstrate here is what is known as the hydrologic cycle. This shows the interlocking coordination which is necessary between your hydrologist, your hydraulic engineer and the meteorologist, if this problem of water is to be tackled effectively. Here is where we interlock with the water resources branch, where the problem can only be progressed on a joint basis.

The water cycle or hydrologic cycle is schematically predicted here and it is a closed circuit, so it does not matter where I start in the description. Let me start with the oceans. There, with the effect of solar radiation, water is evaporated from the ocean, condenses when it reaches a certain level of the atmosphere, is transported over the continents by the upper winds, is steadily cooled to the point where the cloud drops coagulate into rain droplets and they fall out and you get precipitation either in rain, snow or sleet, and so on.

From that point on you have a whole sequence of events. Part of the moisture that falls on the continents falls on vegetation, is used in plant growth, and is also evaporated from the surface of the leaves, so we have what we call evapo-transpiration, which takes place immediately the rain falls. Immediately the ground is wet there is a water feedback into the atmosphere from vegetation.

Part of that rain runs down into rivers and lakes. From your lake surfaces, of course, you have a feedback of evaporation the same as you have from the oceans; and both on the bare ground and in the rivers and lakes you have seepage into the ground with the accruals of waters called ground water. Then from the rivers and lakes you have a steady run-off into the oceans and then the cycle starts again,—evaporation from the oceans, condensation in the clouds, a transportation over continents by the upper winds, formation of rain and the cycle keeps going on.

If you stop this cycle it would take only a few days for the continents to become deserts. The holding time of the water in the atmosphere is extraordinarily short. It naturally varies around the world, but the total water budget in the atmosphere at any particular time is quite a precarious economic situation, and that is why you have cycles of droughts and severe floods. This is a sort of key concept in the approach to the water problem, this hydrological cycle, and the name appears again and again in the literature.

Perhaps, sir, if I transfer my papers to the other end of the table I would save the committee's time.

The part of meteorology which deals with this hydrological cycle, principally the precipitation and run-off factor, is known as hydro-meteorology, to indicate the linkage with scientific hydrology and hydraulic engineering and as merely an example of how it is applied I brought copies of a little presentation that was made to the royal society of Canada back in 1957, which details hydrometeorology and its application in Ontario. It could equally well have been written with regard to any other province. It happened to

be Ontario. The starting point of hydrometeorology in Canada was immediately after hurricane Hazel and Mr. Bruce, the author, was the man we assigned to assist the provincial government in this situation.

The field of the application of meteorology to water problems, is so complex that I thought, sir, perhaps the best way to approach it was to take a series of specific examples which will illustrate fields. I will talk to the specific examples and hope that in so doing the field to which it is related will be sufficiently described.

The first of these, then, is the design of major dams. Actually, the design of the dam itself is not a meteorological problem; it is an engineering problem. But in order to determine the factors that have to be integrated in the engineering design one must know the amount of water that has to be contained. The dam, we will presume, is a multi-purpose dam, as most of them are in Canada, serving for both water storage and flood alleviation. If it is to alleviate floods it has to alleviate the bad floods along with the small floods, and that is where the meteorologist comes in—what is the maximum possible flood that will occur, we will say, in fifty years, in a hundred years or a thousand years? Which one the engineer takes is largely a matter of economics. In these things he would normally have to take some kind of a gamble against the cost of building a dam to face the most fantastic storm that could ever be imagined—in which case you would be putting a dam the size of the Boulder dam on a creek that went dry in the summer. So the problem facing the meteorologist is to make a scientific assessment of the maximum storm rainfall over the watershed that is to affect that dam.

With nothing but short-period records of most of the watersheds to work on, the technique is that you look around the continent to study storms that have a similar character. It is a matter of pure scientific judgment as to which of those storms that occurred could occur in the area being studied. Then you take the precipitation from one from perhaps a thousand miles away, transpose it over your watershed and then make reasonable assumptions on the state of the ground at the time that rainfall was precipitated.

Here again the judgment factor enters because naturally when one wants to play safe with the thing one could take the worst storm and put it down in the area just when the snow cover is maximum and let the whole thing run off and one would get a fantastic output. There are judgment factors entering into it all along, where you have to make a reasonable assumption that the wettest storms happen at times other than the spring; therefore you assume that the snow melt is at a different time to the maximum precipitation.

The end result of that analysis is a communication to the design engineers of the probable maximum precipitation and an estimate of the speed of the runoff. This, then is communicated as design goes on. It also enters into the design of the spillway which is the protection feature to prevent a dam overflowing and inundating towns and villages downstream.

As an example, before hurricane Hazel, this type of meteorological work had not been done in Canada. Hurricane Hazel caught the public imagination. Something had to be done, because too many structures were destroyed. Since that time I think I am safe in saying that every dam designed in Ontario has gone through this process of the communication of meteorological data to the design engineers before the designing was finalized. The spreading of this technique across Canada I will refer to towards the end of my talk.

The next big subject is the operation of the dams. Most of these dams, as I have mentioned, are multiple purpose dams serving both for flood control and water conservation. If the dam was single purpose, just for flood control, the operation would be very simple—you would spill all your water in the winter, lock your gates and just spill the flood water at a normal efflux to prevent any damage. But if you did that and the dam was a multiple purpose dam, you would probably enter the summer in most years with the dam one-third full, so that, you would not have any water for conservation, irrigation, or other uses.

So that the problem facing those operating dams is how much water do you spill in order to contain the crest of the flood without having to spill too much, and yet end up after the spring melt with the dam full. Here again, the meteorologist enters into both the climatological side, which gives him a picture of the normal operation, and the forecasting side, which gives a short-period indication of when to spill in anticipation of a flood crest, and when to hold because the flood crest appears to be past.

On those rivers that flood, and particularly those without dams the science of meteorology has a capability of flood warning to give short period advice to those downstream who are likely to suffer property damage and, in extreme cases, loss of life. That is a side that is only in its infancy in Canada. It has been developed very extensively in the United States, jointly by the United States weather bureau and the corps of engineers. They did a very careful study of the financial aspect of it because it is an expensive business. To do flood forecasting for the short rivers you need a very dense network of gauging and measuring stations. The longer rivers are measurable following a flood crest by a simple gauging. The short rivers are a straight forecasting problem because the floods are of a flash nature.

In the United States, in spite of the higher costs of river forecasting service, the benefit to cost ratio in their analysis was 30 to 1, which sounded like a reasonable investment. As I say that type of operation in Canada is strictly in its infancy but the science permits of it if the cost of the service is justified.

I would like to turn next to the question of irrigation, because in a multi purpose dam a good number of them will be storing water for agricultural irrigation purposes. Here again two problems, one of design and one of operation. In the design field the question is as to the frequency of droughts, their severity, and their durations. This is a key factor in determining the size of the dam to contain the necessary amount of water to carry you through those periods and, just as in designing a dam for floods, you have to take a calculated risk.

If you wanted to protect yourself against any drought that might occur in the next thousand years, the body of water you would have to store would be extremely large. What we attempt to come up with are frequency tables to show the amount of water that would be needed on the basis of a recurrence frequency of drought of ten years, twenty years, fifty years or one hundred years, so that those who are responsible for spending the amount of money will know what risk they are taking and the need can be translated into dollars and cents.

Of course, in this work we are intimately connected with the Department of Agriculture. You will note that the paper which I brought down on the scheduling of irrigation is a joint paper between George Robertson, one of our scientists, and Dr. Holmes of the Agriculture Department. Our man, George Robertson, actually works right inside the Department of Agriculture, because we have seconded him to it for these special jobs requiring a team effort.

The scheduling of irrigation presents special problems and is in many ways the key to the successful use of water for agricultural purposes. If you have plenty of water you can open the irrigation gate every time the ground looks dry. You will do some good, and probably some harm too, because the chances of flooding the field and damaging the crop by an abundance of water is about equal to the chance of not giving it enough. So the scheduling of the irrigation demands attention. Once it is understood in the scientific sense it is easy to teach the actual farmer.

The determination in the scientific sense is not so easy because it depends on the parameter evapo-transpiration which is actually linked with the crop and the ground. If you have rotation of crops your evapo-transpiration factor might change. It depends on the depth of the roots of the crops.

I do not want to go into too much detail. The little paper, I think, will fill this picture out. Suffice it to say that here the meteorologist, the agronomist and the hydrologist form a team giving advice to the farmer on how to make use of the water; and if that maximum use of water is made, a small amount of water can be spread a long way and promote a good growth and a reasonable crop yield.

From there I would like to go to lake water levels, currents and winds in the larger lakes, because they present special problems. I regret I was unable to get multiple copies of this, but last December at the American association for the advancement of science meeting in Chicago, our Mr. Bruce and the university of Toronto's Dr. Rogers, gave a paper on the water balance of the Great Lakes system. I have a copy and I will be happy to leave it with you. This points up the problems specifically with respect to the Great Lakes.

We also had in February 1959 a symposium on the Great Lakes under the auspices of the royal meteorological society, and copies of this are available in quantity.

The problem briefly, from the meteorological side, is one of winds, waves, precipitation and evaporation, because your winds and your waves enter into problems of erosion, in breakwater design, in harbour design, and the precipitation and evaporation are an essential part of the over-all water balance. Here our scientific ignorance is really colossal. We have really no sound idea of the actual precipitation that falls on the Great Lakes themselves. We have a fairly good idea of the precipitation that falls on the lands surrounding the Great Lakes; but the Great Lakes, after all, are a substantial area and we have no accurate measurement of the precipitation into the lakes themselves—which, of course, is 100 per cent catch because you do not get any seepage to ground or evaporation prior to its going into the lakes.

The problem is not simple. We think that the precipitation over the Great Lakes themselves is less than on the surrounding lands. We are happy to say that a scientific endeavour was launched last year and is now, I hope, on a sounder financial basis, where the university of Toronto will direct a major scientific effort into the limnology of the Great Lakes, which includes meteorological and precipitation problems. It is a sicentific effort which will be directed by the University of Toronto. The ship belongs to the Royal Canadian Navy. It is one of the gate vessels from Halifax. It is supported by water resources, by ourselves, and by the various provincial departments; and the university of Western Ontario will also be co-operating. This will be the first major scientific effort in the Great Lakes, and our hope is that from this we will be able to fill in these gaps in our knowledge over the next five to ten years, and perhaps then without a similar costly research be able to translate that knowledge to lakes such as lake Winnipeg and the other large lakes across the country.

Precipitation we have already mentioned. The problem of just measuring it on an unstable platform in the middle of the lake is a nice teaser. We

think we are on the track. Evaporation is another very important factor because, while in Ontario the total evaporation during the year is less than the precipitation—in other words, you end up with a plus—in many other parts of Canada this is not so.

For example, you take the interior of British Columbia, the Kootenay and Okanagan lake areas. Evaporation there is about 35 inches of water a year, and precipitation is between 10 and 17. So in the dry belt you are constantly ending the year with a negative water budget in this hydrological cycle. Thus, you are dependent on water coming into the area from sources where a plus result is possible.

Of course, the net result of precipitation minus evaporation, plus inflow from other areas, determines the amount of water that you have to use—unless you go into some artificial means of increasing it. And as I say the divergence of opinions—and they are large with respect to this water budget of the Great Lakes—is fantastic today, by several orders of magnitude, simply because the key values are not known. For this whole problem of water planning of the Great Lakes and St. Lawrence river I would suggest it is quite vital that this information be obtained as quickly as possible.

Then, going from that to the rainfall-intensity-duration-frequency table—that is quite a mouthful and we put hyphens between each word to make it more difficult—this is the parameter that is needed for designing storm sewers, spillways for farm ponds and other small ponds and general urban drainage problems. Because there the maximum load on this type of structure is not necessarily the spring runoff; it is the sudden downpour of rain from a thunderstorm or from a spring storm just as the snow is about ready to go. It is a combination of the intensity of that rain, its duration, and the speed of runoff; because as you urbanize an area and pave roads and have close cut grass around the houses, water runs off much, much faster than it does when the same land is farmed. So the maximum design criteria increase as the area is urbanized; and, naturally, town planners want to put in their storm sewers and by-passes of sufficient size so that the area has a growth potential from that standpoint.

Up until last year the problem here was solved very largely by Canadian engineers looking at data that had been developed for areas in the United States and just closing their eyes and using it, because we did not have the staff in Canada to work up the data. Our network of instruments is certainly deficient from the standpoint of giving reliable information. But what we have done—and here there were sufficient copies passed around, and you will notice it is by the same author, J. P. Bruce. This is because the hydrological section in our headquarters is just one man, so that same name keeps appearing. He has taken the sparse network of automatic rain gauge records that we have and come up with design figures for most areas of Canada. They are approximate; they need a lot of refining; but at least now they are available.

To give you the order of magnitude of the need for these figures, since last summer, when these figures became available, they have been used in the design of over $10 million of storm sewer and by-pass facilities in the city of Toronto alone. What the figure is across the country, I have no idea.

The need for this was very great. This does not answer all the questions which are intimately connected with our cross-dicipline studies of water resources and the change in run-off characteristic by urbanization. This merely gives the rainfall intensity and duration frequency occurrence: the run-off has to be assessed separately.

Going from that to an estimation of the water yield and flood flows on watersheds, if the watershed is gauged by a network of river gauges—which

is part of the water resources branch activity—then a meteorologist merely enters in an advisory sense in the transposition of maximum storms, because the flow conditions in the watershed then are amenable to an engineering, and scientific hydrologic approach.

In an ungauged watershed—and we have many of these across Canada —we have to put our heads together with the hydrologists and the engineers, using the storm transposition technique. Making an estimate of the evaporation from the watershed, we can make a modestly successful estimate of the sort of character and life history of that watershed under flood conditions; and also under sustained yield conditions, because this, after all, is equally as important as the flood in assessing the hydro-electric potential of that watershed.

It is very much of a second best proposition, but we do—and I will mention some specific instances in a moment—conduct such studies on watersheds for which there are no readings at all except our basic national rain gauge network, so we have some idea of how much water starts down that cycle. Using straight scientific judgment, we come up with a first approximation. But for any accurate work, the gauging of the rivers is a *sine qua non*.

Passing from that to evaporation: I have talked about evaporation and its essential role in the hydrologic cycle, but there is another very important role which it plays. That is, as soon as a dam is built and water contained, the evaporation from the larger body of water created by the dam goes up several orders of magnitude as compared with the evaporation that takes place on the surface of the stream that was dammed. These evaporation losses are sufficiently serious in many areas across Canada to represent several feet of stored water in the course of the growing season.

There are certain techniques that can be used for reducing evaporation. Evaporation fundamently being a product of the wind, plus solar radiation, you can construct shelterbelts around the margins of your reservoir. This is quite effective for the small and medium sized reservoirs. If it is large, the sheltering effect soon disappears a few hundred yards from shore. But it does have a measurable effect.

The other approach—which has been progressed quite extensively in Australia, where you can imagine that the problem in the central part is of the order of several times larger than Canada—is by spreading a film of cetyl-alcohol over the reservoir. In that way you can prevent evaporation almost completely. The trick is that that is a monomolecular layer and if wind comes up, the layer itself can be broken and evaporation sets in. But in the calm, hot summer weather that is predominant in many dry areas, this cetyl-alcohol treatment deserves serious consideration. They are quite optimistic about it in Australia. Most of the work there has been done by Dr. Priestley in their research division, and has been published.

The CHAIRMAN: Is that an expensive operation?

Mr. MCTAGGART-COWAN: Using cetyl-alcohol is expensive, and economically it is only justified in those areas where evaporation counts for a substantial part. If it is going to remove up to half of the stored water, then the cost of using cetyl-alcohol is justified. If it is only going to remove one-tenth or one-fiftieth, the answer is that it probably is not. But the researches into this are still in their early stages—and surely there is another substance that will do the same thing and cost a lot less. This is the challenge. And, of course, the substances you can use depend upon whether the water is strictly for agricultural purposes or whether it is also for domestic consumption. If it is for domestic consumption, there are certain substances that the population would not tolerate, which agriculturally would be perfectly safe. So I offer it as one approach for the small and medium sized reservoir. For the larger reservoir, no, I do not.

I go to another aspect, and that is the water balance investigations, which include the manipulation of vegetation to improve water resources. Here we run into what to me is one of the most intriguing parts of this whole complex, and I use three specific sources. There is the Napanee watershed in Ontario, from which the town of Napanee gets its water supply, and about half way down the river there is a wetland, which is essentially just a marsh. Those farmers who look with longing eyes on the Holland marshlands are, of course, always anxious to drain these marshes because they think there is a gold mine hidden in the black muck underneath. But if you drain wetland like that, there are a number of consequences that are not perfectly understood.

Certainly that wetland is a primary source of seepage to produce ground water. The replenishment of that ground water is essential if your farm wells are going to produce water for farm use. Also, it is a nice cushion or muffler for the variations in precipitation and evaporation. It is in itself a natural reservoir. Even though the depth of visible water in this marshland may appear to be only a matter of inches, its depth in terms of total water stored can be many times as great.

Then, on the other side, the proponents of drainage argue that if you allow that marshland to exist, your evaporation is tremendous compared to if you merely dug a ditch through the marsh and passed the water in a narrow, quick-running stream and built a dam down below to facilitate your water conservation. In studying this problem we ran across a very interesting Russian book. I might interject here that we profit from a very good exchange of scientific information with the hydrometeorological service of the U.S.S.R., and this was one of the books that they sent us.

It may interest you to know that the meteorological service in the Soviet is called the hydrometeorological service, which indicates the importance which they attach to water management problems in the meteorological sense. Unfortunately, this publication is not available in quantity. I think additional copies could be obtained. But we have presented a condensation of that book, showing the type of activity that goes on in the Soviet to determine, with regard to these wetlands, what is the best thing to do with them. It is quite a short article, and it is in the conference report, a copy of which I will leave with you, sir.

In essence, though, they put a tremendous amount of energy into this. Also, of course, with regard to conservation, the biologists and zoologists all get into the act, because the wetlands are a haven for water fowl, and if you drain them, that aspect goes.

So one aspect of that water balance problem is your wetlands: should you retain them as a natural resource; should you drain them in order to turn them into another type of natural resource? I think that each one has to be studied by itself. This is the Soviet answer—that there is no simple answer. The Holland marsh technique is probably right, because it has been done and the water levels in the surrounding wells are still reasonably adequate.

With regard to the Napanee one, there is a great big question mark after it—whether, if that is drained, the water supply from that may just dry up in the summer.

The next example—this one I have just given you is rather small—is fantastically large, and that is the problem surrounding the eastern Rockies as far as the conservation board is concerned, and the Saskatchewan river. The amount of water that can flow down that river depends on the snow catch and retention in the headwaters, which are largely in the areas served by the eastern Rockies Conservation Board.

There have been preliminary interdepartmental discussions on this. It will require the common approach of a considerable number of scientific disciplines in order to come up with a reasonable recommendation as to what should be done. The forestry people enter into this; the agricultural people do and, certainly, the water resources branch is the hard core, because this is what we are talking about and we, the meteorologists. The zoologists enter into it.

To give you an example: assume a certain snow catch in the high levels of the mountains starts to melt. If it flows through the forests a large part is used for the growth of the trees. Trees are lavish users of water. But a certain amount seeps into the ground; and a large amount is transpired because of the tremendous leaf area exposed to the sun. If you have a forest you lose a lot of water as the snow melts and runs off. But, if you had that land as grassland, you would find that it is a much more economical user of water. It will hold it back enough so you do not get bad floods, but it will certainly dump more water into your reservoirs than a similar area of forest. If you disturb the balance between your forests and grasslands, you upset the balance of nature with respect to your wildlife. In reverse, if you cut down your coniferous trees and rely on the growth of the deciduous, your larger animals—such as the elk—can be used as a control measure to keep the deciduous trees from over growing your grasslands. Increase your elk population and they will increase your grasslands. That is on the positive side.

Now, on the negative side. If you destroy this existing balance, what do you do to the water table downstream in the province of Alberta? This has to be looked at because you are trying to gather the water behind reservoirs before it seeps into the ground. To what extent is the seepage into the ground on the upper levels of the foothills? To what extent does it contribute to the water levels in the agricultural areas of Alberta? That is something that has to be answered. This is amenable to research; but it will require a concentrated effort to acquire the necessary information. Therefore, there are a wide number of disciplines that are needed. You are going to get some very strong conflicting views among those outside the scientific discipline, who have a stake in the common result. But certainly, in my humble estimation, it is a problem that has to be tackled.

As I will show in a moment, the water resources moving down the Saskatchewan river are a very marginal proposition, and now we are in rather an above-average era in the water cycle. If we are planning resources on the basis of the present flow of the Saskatchewan river, we should take steps to see if there cannot be something done artificially to improve the capability of carrying it over a drought era.

A suggestion has been made in regard to snow fences. For example, take a northward basin gulley in the mountains and build the right type of snow fence on the adjoining ridge, and that will increase the snow catch by 50 or 100 feet. If you distribute the wind pattern you can fill the whole gulley. How many gulleys are there? What sort of structure? This is all possible. It is not scientific nonsense. However, although it needs a lot of research, the benefits could be substantial.

The third problem in this field is the question of glaciers. A good number of the streams upon which the population depends are glacier fed, in the western part of our country. The glaciers in these parts are receding. What is the long-range prospect? If they go on receding, they come to the end of their tether; the streams dry up, and it does not matter what resources you have put in downstream, you have nothing to get. However, there is still a lot of ice in most of these glaciers, even though they are receding. But there are glaciers within Canada, even in the northern parts of Canada, that are in their final stages of death. They are just little baby ones. Therefore, this situation cannot

be ignored. It is a more difficult field in which to come up with answers, because it depends on the very long-range swings of the climate. However, there are glaciers in Canada which have started to grow again. Are these freaks of nature, or an indication that we are rounding the bend and can stop worrying about the retreating glaciers?

The McGill-Jacobsen expedition to Axel-Heilberg Island is going to study three such glaciers in that area this summer and, I hope, the next three summers. One of these glaciers is in the final stages now; one is retreating rapidly; and the third is about holding its own. These are all located within an area of approximately ten miles, and in this area you have these three types. Efforts will be made to try to find out what the life cycle is that makes this difference. Efforts will be made to see if we can uncover the clues as to whether these glaciers which are not retreating are freaks of nature or early indications of having rounded the bend between two ice ages. As our meteorological observations in Canada only go back just over 100 years, this is a very difficult field of research. The first observation was in Toronto in 1839. There were observations, of a fragmentary nature, in Quebec City for several years before that.

However, the records of meteorological observations dates only from 1839 which, in terms of ice ages, is an infinitesimal period of time. So, we have to get at it by indirect means, by consorting with the nuclear chemists, using carbon 14 and all the technical information that has been developed in the post-war era. Now, that is in the area of pure research.

The Napanee and eastern Rocky subject is a mixture of pure basic and applied research. It can be processed.

I would like now to move on to the ice formations and melting in rivers and lakes. This is a field to which increasing attention has been given. I was interested in Mr. Cote's presentation to you of the definition of "navigable waters" because a few years ago we inherited the responsibility for ice observing and forecasting in navigable waters, because of the desire to navigate further into the winter and, possibly, throughout the year. We were "dumped" into that field. We should have had a five-year look at it before we started, but we had to start and then have a look at it. This is an expensive proposition, as your primary data gathering tool is the airplane, and airplanes are expensive. The capabilities already have been seen. As you know, we had a quite successful season in the Gulf of St. Lawrence, the Bay of Chaleur, and around there, by playing our part in extending the shipping season by timely advice and forecasting of the movement and the generation of ice.

On the research side, we made a start on the great lakes with the use of a ship— the *Porte Dauphine,* which has been on the lake all winter. We have recorded, for the first time, the temperatures of the waters in Lake Ontario throughout the year. We have a first approximation of the heat budget of Lake Ontario. This is a first step in forecasting the opening of navigation in the great lakes. It would be worth while to hasten their progress in that. Now, there is a certain amount of guessing involved, but the tools are available to take the guesswork out of it. Time, money and scientific personnel to do the work are the things that are lacking.

Finally, in this sample taking that I have done, I would refer to aquifers. They are the mechanism by which farm wells—either dug or drilled—are available for use as supplies of water. I have referred to them in connection with the wetland study and in connection with the eastern Rockies study. However, they deserve study on their own, because a large number of farm wells exist in areas where there are no adjacent wetlands or adjacent mountains which would have a snow reserve, and yet those waters are replenished through normal seepage through the ground from precipitation and snow. The over-all

life cycle there is not fully understood, and yet on that depends the judgment on how much water you can take out of your well without lowering the water table. With the number of municipal water supplies across the country, dependent on pumping water, this is going to become an increasing problem.

The CHAIRMAN: Mr. McTaggart-Cowan, I am afraid I will have to interrupt you for a moment. We have to adjourn this morning at 10.30 because there are a number of other meetings and commitments.

As it would be almost impossible for you to complete your presentation in the remaining time I would ask, for the benefit of those who are here—there are not always the same members at the meetings—that you would give them an opportunity of questioning you in regard to your presentation up until now. I have a number of questions and, I am sure, other members have.

Mr. DUMAS: Mr. Chairman, may I say that Mr. McTaggart-Cowan's presentation has been very interesting. In regard to the lake water levels on the great lakes—and I believe you mentioned we did not know too much about precipitation on the lakes but that you are planning to do some study in regard to this aspect—how do you plan to organize the work? How do you plan to measure precipitation?

Mr. MCTAGGART-COWAN: The initial approach will be on this research ship, the *Porte Dauphine*, which is operated by our marine branch of the Department of Transport, and it provides the platform for the university of Toronto group.

Mr. DUMAS: And this vessel was employed for the first time last winter—

Mr. MCTAGGART-COWAN: Yes.

Mr. DUMAS: —in taking the temperature of the water; and next summer this vessel will be used to establish a platform to measure precipitation.

Mr. MCTAGGART-COWAN: Yes. That is only one of many scientific programs with which we will be proceeding.

Mr. DUMAS: What are the other programs?

Mr. MCTAGGART-COWAN: Well, it will cover the full gamut of limnology, wind drift on the surface waters, the currents in Lake Ontario, the effect of erosion, and biological studies—that is, what organisms there are there to support the fish population, which is an important problem. There will be studies on water pollution and the passage of atmospheric pollution over the lakes from one side to the other. It will involve the whole structure of the lower layers of air over the water, and it will be necessary to take measurements of evaporation and precipitation.

Mr. DUMAS: And the university of Toronto will participate?

Mr. MCTAGGART-COWAN: They will direct the scientific activities.

Mr. SLOGAN: Along the same line, Mr. Chairman, I have a question in regard to air pollution over the great lakes. The great lakes are in the industrial centre of North America. Is air pollution—carbon in the air, and carbon dioxide—going to stratify and cause much less evaporation on the great lakes because of the sun not getting through?

Mr. MCTAGGART-COWAN: That is one of the things we plan to find out. We do not know yet, and without measurements anything I say would be pure speculation.

Mr. SLOGAN: There has been a noticeable increase in the amount of radiation in the water surface of the lakes from radioactive fall-out. Do you take samples for the Department of National Health and Welfare on this?

Mr. McTaggart-Cowan: Whenever one of our meteorological observing stations is at a location where the Department of National Health and Welfare wishes data we do it for them. We have technicians who are trained to take physical measurements and they are available to the Department of National Health and Welfare. In the same way if the water resources branch have a stream gauge station at which it is worth while taking precipitation we provide the instruments and their people do the work and vice versa.

Mr. Slogan: Is your department doing this at the present time? Is it taking air samples and water samples?

Mr. McTaggart-Cowan: Yes. The results of course are handed over to the Department of National Health and Welfare. We do not analyse them; they do that.

Mr. Dumas: I understand Mr. McTaggart-Cowan will be back here again.

The Chairman: I hope he will.

Mr. Dumas: Will you give us some information regarding the meteorological stations you have across the country?

Mr. McTaggart-Cowan: Yes. That was the final part of my presentation. Coupled with that is the key question of the cycle between droughts and wet periods over the span of a century. This is very important to our work.

The Chairman: Mr. McTaggart-Cowan, in British Columbia, in the coastal area of all places, there has been a good deal of experimentation in rain making. Have you any part in the possibilities of rain making?

Mr. McTaggart-Cowan: I will answer that this way. We have one of our major scientific projects at the present time called our precipatation physics project. It is a joint effort with the national research council, supported by the forestry industry, and we study the whole mechanism of the formation of precipatation. It is surprising that we as scientists have been looking at rain ever since man was and there are a lot of unknowns as to exactly what starts the cycle from the little cloud droplets that will not fall to those that will. There are several theories but in each theory there is a gap.

As a second part of that research study we are also examining what happens when you inoculate the cloud with silver iodide. This again can be done under controlled conditions in the laboratory. You can have a cloud chamber inoculated by silver iodide and form ice crystals. To what extent that can be taken out of the laboratory and put into nature is what we are trying to find out. In the experiment we are using aircraft to place the inoculant in the cloud. So we know it is there. This is opposed to putting it out at ground level and hoping to carry it up. We estimate it will require another four years before we can get statistically valid results from that research.

An honest answer to your question so far as research right around the world is concerned is that I think it can be said that under favourable conditions on the seaward slopes of mountain ranges facing large oceans, inoculation of clouds can produce a measureable increase. As you see I have put several qualifications in that statement. We do not know whether or not it will do any good in the prairie provinces or in eastern Canada.

Mr. Dumas: But some experiments are being carried on?

Mr. McTaggart-Cowan: Very definitely. It is our largest single scientific project. There are actually two. We are taking the same approach on the hail problem in Alberta. The former project is being carried on in the boundary between Ontario and Quebec.

22871-8—2

Mr. DUMAS: Some of these experiments are being carried out also by private organizations.

Mr. MCTAGGART-COWAN: In our terminology they are experiments in the operational sense but not in the scientific sense. The wide variation in natural rainfall requires scientific experiment. It has to be very very carefully designed. We are not out to produce water for useful purposes in this experiment.

Mr. DUMAS: But some private companies are doing that.

Mr. MCTAGGART-COWAN: Yes.

Mr. DUMAS: I understand the Shawinigan Water and Power Company are doing this. Have you any information on the work they are doing? At the next meeting would you comment on that?

Mr. MCTAGGART-COWAN: We are aware of their work.

Mr. DUMAS: And you have the information?

Mr. MCTAGGART-COWAN: Yes.

Mr. DUMAS: They keep you informed.

Mr. WOOLLIAMS: I noticed you mentioned the hail problem in Alberta. There is a lot of diversity of opinion as to whether or not hail suppression has any value. This is something I would like to hear a comment on. I believe there is a hail suppression program being carried on by a private corporation.

Mr. MCTAGGART-COWAN: I can answer that briefly now if you wish.

The CHAIRMAN: Yes.

Mr. MCTAGGART-COWAN: Hail suppression is even a trickier thing to work with than rain. Rain is bad but hail is even worse. The only honest answer I can give you is that this commercial attempt at hail suppression in Alberta may do good, it may do nothing, and it may do harm. That pretty well covers it. Those three possibilities are all honest scientific possibilities. It is in order to determine which one that we have this large hail research project in collaboration with the national research council and the Alberta research council with McGill university as the prime contractor. We will get the answer, but it may take another five years. Right now we have to give all three possibilities. To show how our opinions are developing, if you had asked this question this time last year I would have said it may do good or do nothing. However, from the results we gathered last year and which are being analysed at McGill university it is necessary with reluctance to add that third possibility.

Mr. WOOLLIAMS: It is pretty sad for some of the people who may be spending $125,000 a year or more if it is doing some harm.

Mr. MCTAGGART-COWAN: When we added that third possibility we attempted to get the money to double our expenditure on that project because as soon as we added that possibility, not having previously suspected it, it became really urgent and we hope to spend twice the amount of money on that research project this year that we did last year.

The CHAIRMAN: Thank you very much for your contribution. I am sure there are a number of questions in the minds of the members. We would like to hear the rest of your presentation at the next convenient opportunity. I myself have a number of questions which are pertinent to this subject.

We will now adjourn until Monday at 11 o'clock when we will meet in room 238S.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 4



MONDAY, APRIL 4, 1960

Estimates 1960-61 of the Water Resources Branch
of the Department of Northern Affairs and National Resources.

WITNESS:

Mr. P. D. McTaggart-Cowan, Director, Meteorological Branch,
Department of Transport.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22873-4—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, April 4, 1960.
(5)

The Standing Committee on Mines, Forests and Waters met at 11.15 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present*: Messrs. Baskin, Dumas, Fleming (*Okanagan-Revelstoke*), Hicks, Kindt, Leduc, MacRae, McFarlane, McGregor, McQuillan, Payne, Simpson, Slogan, Stearns, and Woolliams. (15)

*In attendance*: *From the Department of Transport*: Mr. P. D. McTaggart-Cowan, Director, Meteorological Branch. *From the Department of Northern Affairs and National Resources*: Mr. E. A. Côté, Assistant Deputy Minister; Mr. J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Mr. McTaggart-Cowan continued with his statement and dealt with rain gauge networks, international developments and climatic fluctuations, and was questioned thereon.

The witness emphasized certain points by the use of charts.

Mr. McTaggart-Cowan tabled *one* copy of the following documents and commented thereon:

(1) Technical Note No. 25—
*Design of Hydrological Networks*, by Max A. Kohler;
Technical Note No. 26—
*Techniques for Surveying Surface Water Resources*, by Ray K. Linsley; (*Identified as Exhibit No. 3*).

(2) Climatological Observing Stations; (*Identified as Exhibit No. 4*).

(3) *Some characteristics of Precipitation in the Canadian Prairies*, by R. G. Kendall and N. K. Thomas. (*Identified as Exhibit No. 5*).

(4) *Variability of Annual Precipitation in Canada*, by Richmond W. Longley; (*Identified as Exhibit No. 6*).

(5) *Preliminary Estimates of Probable Maximum Precipitation over Southern Ontario*, by J. P. Bruce; (*Identified as Exhibit No. 7*).

(6) *Agricultural Meteorology Canadian Society of Agronomy*; (*Identified as Exhibit No. 8*),

and the following document referred to in his statement on Friday, April 1:

(7) *Plan for Flood Control and Water Conservation* presented to the Metropolitan Toronto and Region Conservation Authority; (*Identified as Exhibit No. 9*).

The questioning completed, the Chairman thanked the witness for his presentation.

The Chairman announced that Mr. Fox, a United States authority on water problems would appear before the Committee tomorrow, Tuesday, April 5th.

At 12.20 p.m., the Committee adjourned to meet again at 9.30 a.m. Tuesday, April 5th.

M. SLACK,
*Clerk of the Committee.*



22873-4—1½

# EVIDENCE

MONDAY, April 4, 1960.
11:00 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. We have Mr. McTaggart-Cowan with us again; and we will ask him to proceed with his presentation.

Mr. P. D. McTAGGART-COWAN (*Director, Meteorological Branch, Department of Transport*): Thank you, sir. I thought that perhaps this morning, sir, I might very briefly go over the hydrometeorological activities that we now support, having at your last meeting fairly well covered by example the field in which meteorology has a bearing on the water resources. We have only three scientists working in this entire field. One of them is at our headquarters, in what we call our hydrometeorological section.

The CHAIRMAN: Would you mind speaking up, Mr. Taggart-Cowan.

Mr. McTAGGART-COWAN: I am sorry. One of the three scientists we have working on hydrometeorological problems is located at our headquarters and is engaged at the moment in an investigation of the maximum rainfall, snowmelt and flood studies on the Quebec north shore as a preliminary for the engineering studies of the hydro-electric potential of that area, where we understand over the next 10 to 20 years there will be substantial developments in the engeneering state.

As soon as he has completed that, he will go on to a similar study for the Saint John river in New Brunswick. He will also be collaborating with the university of Toronto for the operation of the research ship *Porte Dauphine* on the Great Lakes. He has presented a study of the frequency of one and two-month droughts across the country and is responsible for developing the recording rain gauge network across Canada and our capability to measure evaporation.

The second meteorologist we have assigned in this field is seconded to the conservation branch of the Ontario Department of Planning and Development. That was a secondment which grew out of the results of hurricane *Hazel.* His responsibilities are twofold: one, to develop and operate a river forecasting and flood warning service for southern Ontario waters, and secondly, to provide design criteria for dams and other flood alleviation structures in that area.

The third man we have working in this field is seconded to the prairie farm rehabilitation organization in Regina. He took up his appointment only late last year and is busy studying the rainfall of the 69 worst storms in the prairie provinces since the year 1857. These design studies will then be placed in the hands of the engineers and used for the general structures design being developed by P.F.R.A. There are minor activities at our forecast offices, but they are purely of a secondary service nature.

Coming now to the observing networks, I thought the most important from the standpoint of water are the rain gauge networks in the country. Here we have a comparison—I apologize, again, for the size of the figures—between the situation in Canada and in other countries. You can compare the number of rain gauges in two ways, either per 10,000 population, which is perhaps a measure of the cost per taxpayer for this facility; or, per thousand square miles, which is the basis to determine what kind of sample you are taking of the precipitation falling on Canada.

Coming first to a comparison with other commonwealth countries, Australia, New Zealand and South Africa, the number of rain gauges per 10,000 of population in Canada is 1.1, whereas Australia has 5.8, New Zealand 6.1 and South Africa 2.8. If you take it on the basis of per thousand square miles, we are 0.4, or one gauge for every 2,400 square miles; Australia is 1.7, or one in every 600 square miles; New Zealand is 10.7, which is one gauge every 94 square miles, and South Africa is 3.5, or one gauge every 290 square miles.

If you eliminate the wasteland areas, then the ratios per thousand square miles are 1.0 in Canada; 3.2 in Australia; 14.2 in New Zealand and 4.4 in South Africa. So that, with either comparison, with respect to the commonwealth we are very much below the others.

If you come to other large countries, the United States, the United Kingdom, Sweden and Norway, then on the per 10,000 population we are about the same. In other words, we have 1.1; the United States, 0.9; the United Kingdom, 1.1; Sweden, 1.2, and Norway, 2.0. But if you then go to the number of rain gauges per thousand square miles—which is the scientific measurement—we are 0.4, as opposed to the United States, 4.6. In other words, we have about eleven times fewer gauges. The United Kingdom figure is 55 gauges per thousand square miles, Sweden is 5, and Norway, 5. So that in comparison with those countries we are taking very, very small samples of the precipitation measurements.

This is our growth curve in the establishment of precipitation observing stations and, as you can see, in the post-war period we have been doing our best to improve the situation. This is the graph from 1870 up to the present day, and at the moment we have about 1800 rain gauges across Canada.

Mr. DUMAS: Eighteen hundred?

Mr. MCTAGGART-COWAN: Yes. The limitation, of course, is a matter of staff—to go out and find the observers, train them and install the gauges; and money to pay for it.

Then coming to other activities in the network field, we have, in cooperation with the eastern snow conference, collected all the snow measurements made by, as far as we know, all agencies, federal, provincial and industrial that take snow measurements, and we publish them on an annual basis. This is done for eastern Canada. It is not yet done for western Canada: there does not appear yet to have been the demand.

If I may turn, then, to liaison. I have already referred to the very close liaison which we have with the water resources branch. We have a good liaison with the various provincial water resource organizations, the Quebec Department of Hydraulic Resources and the Ontario Department of Lands and Forests conservation branch, and so on, across the country. The extent of those liaisons with the provincial organizations depends on their need for our services.

In the international field the scientific meteorological work throughout the world is coordinated by the world meteorological organization, which is one of the specialized agencies of the United Nations.

Last year at its congress it established a mission on hydrometeorology. We have two representatives on that mission, one from the water resources branch and one from the meteorological branch, so that we are represented both on the meteorological side and the scientific hydrologist side. The activity in the United States I have already referred to and, as is shown by a very, very dense network of precipitation recording stations, they are very active in all the fields. I outlined these at your last meeting.

In Australia they finally in 1957 set up a hydrometeorological section of their weather bureau. We established ours,—if you can call one man a section,—in 1958.

Coming now to perhaps one of the most important aspects of the water problem in the prairies, I would like to refer to climatic fluctuations, because measurements taken during any one year or any one period of years are only helpful when they are correlated to the general precipitation over a century or more. Here I have graphs of the fluctuations of precipitation from 1890 through to the present time. If I had plotted the actual values the thing would have been a point table graph. It would have been very hard to see the pattern. So what I did was to take ten-year moving means; in other words, you take the mean of the precipitation for ten years and plot it on the date of the last year. In other words, the figure plotted for 1900 was the mean of the precipitation that fell between 1890 and 1900 and then the figure plotted for 1901 was the mean of the precipitation that fell between 1891 and 1901. This is a statistical device merely to smooth out the annual fluctuations and let you see the longer term fluctuations.

As you see the values here are in inches of water or precipitation.

If you start with Alberta, you will see back about the turn of the century they had an extreme drought with an average for ten years of only 13 inches. Then it very rapidly climbed until in the early part of the twentieth century it reached almost 19 inches of water; in other words, about a 50 per cent increase in a relatively short space of time. It then fell equally rapidly until about 1917. Then there are further fluctuations in an irregular manner; but you notice the droughts of the 1930's are not outstanding. They are outstanding in our minds because we lived through them, but they are nothing like the droughts that occurred just about the time we started taking measurements in the prairies, and are of the same order of magnitude as the droughts that occurred back in 1910 and back in 1900.

Mr. HICKS: Was that because of the amount of wind along with it?

Mr. MCTAGGART-COWAN: Wind is a great factor, because there you have your evaporation. If you have a small rainfall plus above normal winds on the average, then your situation would be worse because you not only have less precipitation but you have greater drying of the ground water.

Then if we go to 1950, where there was a certain amount of flooding, you have this minor peak; and now, as you can see, we are up higher than we have been in terms of annual rainfall any time since the turn of the century. Therefore, from the planning standpoint we cannot plan on having that amount of water available on the average. If you took an average of his graph it would lie well down here.

Saskatchewan runs just about the same. The fluctuation rises between 13 inches and 17 inches rather than 13 inches and 19 inches; and as you see in the 1930's the precipitation was even less in Saskatchewan than it was in Alberta. Now again in Saskatchewan we are at about the same level as the highest months in the last century.

In Manitoba the fluctuation is less, the range being between eighteen inches and 21 inches, but again an irregular rising and falling over the years. Meteorologically, there is no reason to suspect that that will not continue. Just when this will start down is one of the problems we have not yet solved. We are as yet unable scientifically to forecast these longer term trends.

The further highlights in that graph I have just shown you are obtained by taking a half dozen station with longer term records in the province, and averaging those to get a sort of provincial average. If you take an individual station—and here I will use Calgary—the technique is the same as the ten year moving mean. Therefore you can see perhaps this cycling more clearly than in the graph average for the province.

Here you have very, very severe droughts just before the turn of the century, very severe flooding, the heavy precipitation that occurred just after the turn of the century, your three peaks of precipitation and your three drought periods.

Mr. KINDT: Those cycles appear to be about thirty years, in between 1900 and 1930 and 1960. We are into that now—well, no, your cycle is not quite 30 years.

Mr. MCTAGGART-COWAN: Well, with these figures, statistically, you can pick up almost any cycle you want. There is nothing regular about it. These are thrown in relief because I have taken this ten year mean, and therefore smoothed out a lot of the minor fluctuations. If I had taken a five year moving mean there would have been superimposed on this a little wiggle at about every ten years, and then you would have a lot of scientific likeness about some spot cycles, and so on. But scientifically we have found no correlation yet between precipitation and any other measurable parameter, be it solar or terrestrial.

Mr. KINDT: Is it not true that if you had weather data dating back for 200 years you would be able to define those cycles very accurately?

Mr. MCTAGGART-COWAN: No, sir; they have records going back that length of time in the United Kingdom and they have a very, very dense network of stations. In the United Kingdom they have 55 weather gauging stations per 1,000 square miles. In other words, they are taking a very good statistical sample of the precipitation. They have a considerable number of stations that date back for pretty well 200 years, and you cannot find any periodic fiuctuation that has a prediction backwards. In other words, you cannot statistically process the figures for two centuries, and use it to forecast the next trend sucessfully.

Mr. STEARNS: Mr. Chairman, could you not go back 500 years in the average forest and pick out the wet seasons and dry seasons?

The CHAIRMAN: Well, yes, there is some evidence in the forest areas.

Mr. STEARNS: I know we do it at home in the forests.

Mr. MCTAGGART-COWAN: There are several techniques that will give us much more information than we have now. One is a study of the glaciers, called the isotope record ratio. Knowing that water has 0.16 or 0.18 isotopes, and the range of these factors such as winds and so on, using an instrument called a mass spectromoter you can take a core out of a glacier and determine how much has been accreted each year. This is rather a new technique, and as far as I know is not yet being done in Canada. I hope one of the universities will take it up. It is being done in the United States at the present time with rather interesting results, on the Greenland ice cap. I think our work on the glacier would yield us information much further than this we have here. The McGill-Jacobson expedition to the Axel Heilberg island is planning to take cores back for analysis—perhaps not as quantative as it should be, as there are other factors such as the severity of the winters and the winds that enter into it, and so on. But this can be done. It is a question of the number of scientists you can put on the job.

The CHAIRMAN: You have made no attempt as yet to relate forest growth to weather cycles?

Mr. MCTAGGART-COWAN: No sir. As I said we have only three people in the meteorological service working on it. One of them has been tied with southern Ontario as a result of Hurricane Hazel. Our headquarters section has only been in existence since 1958. The other man is completely tied with P.F.R.A. in very vital work that has to be done now if it is going to be effective. There is much we can do, but there is a very great shortage of scientists.

Mr. DUMAS: I wonder if Mr. McTaggart-Cowan has any similar graphs for the eastern portion of the country?

Mr. MCTAGGART-COWAN: I can produce them, sir. I am sorry I did not bring them with me, except I have a small one for Toronto which I can table for the committee. The others would show the same sort of fluctuation, some of the stations much less markedly than Calgary, some of them more.

Mr. WILLIAMS: Mr. Chairman, is there any relationship between the mean average temperature for any one year and the precipitation for that year?

Mr. MCTAGGART-COWAN: Yes, they are correlated; because if you have higher than normal precipitation you will have a greater amount of cloudiness, which will cut down the incoming solar radiation. Therefore by and large you would expect a slightly lower mean temperature. I qualify that "by and large" because it rather depends on the mean flow of the upper layers of air between, let us say, 1,000 and 20,000 feet. If then in the bringing in, in the cloud, the trajectory of that air has been southern, then the southerly aspect of the flow will compensate for the lack of direct solar radiation, and the temperature will not fluctuate on the same basis.

Mr. KINDT: Is there any truth in the saying—of course the oldtimers believe this—that western Canada, Saskatchewan and Manitoba, are getting gradually warmer?

Mr. MCTAGGART-COWAN: Yes, sir. Again I could have brought down graphs to indicate that. We have published papers on the subject because the temperature graphs look rather alike; but there is a general upward trend in western Canada. The fact that the glaciers are continuing to retreat is evidence of that, because glaciers are very good indicators of long-term climatic change. So that as long as the glaciers are continuing to retreat, in the main, the climate is warming up.

Mr. HICKS: There is a little more hot air in Alberta.

Mr. KINDT: One supplementary question to the one I asked before. Is there any effort being made under present technique for determining the cyclical patterns in weather, the same as it is in economic science? Great strides have been made and a fair degree of accuracy of predictability can be made. It is evident from what we have before us now that weather travels in cycles and if you could take it one step further and give a reasonable degree of prediction of what is ahead, it would be a tremendous thing for mankind.

Mr. MCTAGGART-COWAN: I agree completely, sir. The problem in meteorology is that the cycles are not uniform, or if they are this is not a complete cycle. If we had 1,000 years we might do it. At the moment, at the present stage of our scientific knowledge the situation appears so complex that a long cycle is unlikely to exist. There are too many variables in your equations.

To answer the first part of your question, there is a great deal of research going on in these long-range climatic trends in various parts of the world. But there is very little of it here in Canada—again not because we have not the desire or enthusiasm, but because we have not the people. The scientists are just not available.

The CHAIRMAN: Mr. McTaggart-Cowan, what is your opinion of the accuracy of the long-range forecast services that are provided by some agencies? Some industries subscribe to them.

Mr. MCTAGGART-COWAN: Well, in the strict sense of a forecast being an extrapolation, in detail your five day forecast has a reasonable degree of skill if it is used for a city or a township or something larger than a point. Your 30-day forecast put out by the United States weather bureau has an economic value if it is used with regard to an economic interest covering about half the country; in other words, if you are basing shipments of climate-sensitive

materials such as petroleum products and so on across half the country on the 30-day forecast, it will have a value. But to use it with respect to a particular farm, the answer is no.

Mr. PAYNE: Is it in order at this time, while the men from the forest industry are here before us, inasmuch as they have indicated a desire to have available information regarding forecasting to have the witness tell us what, if anything, has been done in this connection, and what his views are relative to the aid that the meteorological department can provide for operators in Canada's forests?

The CHAIRMAN: I think Mr. Payne is referring to a recommendation from a witness from British Columbia lumber operators for the assignment of someone to forecast or a sufficient staff to give a forecast during the fire season.

Mr. MCTAGGART-COWAN: Yes, but I have not quite finished my answer to the previous question. Shall I finish that first?

The CHAIRMAN: Fine.

Mr. MCTAGGART-COWAN: I had dealt with the thirty-day forecast, which is published by the U.S. weather bureau, with the limitations I have given you printed on the back of it, and it is available for public subscription.

Beyond the thirty-day forecast, sicentifically the field of prediction has to be in the field of statistics. In other words, we can come up with the most probable values of the parameters that a particular industry is interested in. That is a statistical forecast as opposed to a dynamic forecast. Actually, the economic skill of such a statistical forecast depends on the extent to which the user has got his problem into the hands of the statistician. With regard to that aspect, we have now got ten years of our back data on to punch cards, and we can process it statistically to meet any specific need. That is just a sample back to 1950. The rest of it we have not yet been able to put on to cards.

To come to the question of service to forestry; there is no question we could do a great deal more than we are doing now. It is difficult to get all the scientific information: the reason we are not is a great shortage of staff. Concerning requests, particularly, the B.C. association of forest products have represented their case for a number of years. We think we appreciate it. We think we could do a lot more than we are. The only reason we have not done it is that we just have not the staff to do it.

Mr. PAYNE: What would be involved in improving this service, with regard to dollars or men?

Mr. MCTAGGART-COWAN: Initially, the assignment of one man, to be based at our office at Vancouver international airport, and employed full-time on operational research in weather problems of the forest industry.

Mr. PAYNE: Just one individual?

Mr. MCTAGGART-COWAN: That is the initial step. Beyond that, the extent to which the results of that one man could be made operational—the staff aspects of it—would not be large; but it is hard to be specific until the research has been done. Perhaps it would be five additional meteorologists.

Mr. PAYNE: What would that run to, in dollars and cents, per year?

Mr. MCTAGGART-COWAN: It depends how much you pay your scientists.

Mr. PAYNE: Well, be generous. What would be the maximum estimate in this regard?

Mr. MCTAGGART-COWAN: This is a somewhat embarrassing question, sir, because the salaries of meteorologists are now under discussion; but, to take a round figure, you could say the price of a meteorologist is around $10,000.

Mr. PAYNE: That is the complete service. I am not trying to pinpoint any particular salary, but I would like an estimate of the cost to establish this adequate service.

Mr. MCTAGGART-COWAN: I can only answer that honestly by telling you what they do immediately south of the border, in the States of Washington and Oregon. They have specialized teams of meteorologists concentrating on the forestry problem 12 months of the year. They are set up in units, and they take their operational unit into the forest area and work from there. The cost of that would be fairly substantial. To keep a team of that sort operating 12 months of the year would run up around $80,000, I imagine.

Mr. PAYNE: Around $80,000?

Mr. MCTAGGART-COWAN: Yes, that is a ball park estimate.

Mr. PAYNE: It would require how many teams to serve it adequately?

Mr. MCTAGGART-COWAN: That is one of the problems we would pose to this research meteorologist who would attack the forestry problem in British Columbia. For the past several years we have had a meteorologist seconded to the B.C. forest service in Victoria, who has been working on other aspects; and there has been a feed-back from him to our forecast office, which has improved the present forecasts about as far as they can go without this fresh operational approach.

Mr. PAYNE: But you feel a service of this nature could, in fact, preclude the development of fires? I mean, damage to standards of timber growth?

Mr. MCTAGGART-COWAN: It would be a factor in it. We are talking about meteorology. It certainly allows one to predict the onset of a dry period, where the fire index would increase substantially. It would also permit the prediction of thunder storms, particularly of the dry variety, that are responsible for starting a number of fires. Of course, beyond that it becomes the foresters' problem rather than the meteorologists'. If the thunder storm is setting fires, somebody has to go along and put them out before they get out of hand. The other aspect—as to what one can do to alter the characteristics of a thunder storm—is in the research stage. There is research going on in the United States, and as a by-product of our Alberta hail study—which I referred to in reply to a question at your last meeting—I would hope we would get information as to what, if anything, can be done to alter the characteristics of the thunderstorm. This might be a forest application, but here I am talking about results of research that have not yet materialized; so it is speculation.

Mr. PAYNE: As compared to what is desired, what service is provided at this time in this field?

Mr. MCTAGGART-COWAN: Routine 6-hourly forecasts of the primay parameters of precipitation, wind, temperature and humidity—from which a calculation of the fire index can be made.

Mr. PAYNE: These are carried through what agencies to the people?

Mr. MCTAGGART-COWAN: Our basic policy there is to put them in the hands of the principal forest production agencies of the province. Then they do the dissemination, out to their field stations.

Mr. PAYNE: Do you convey them through the regular news media, radio and television?

Mr. MCTAGGART-COWAN: Yes, we use that for a rather different forecast; but for the specialized forestry forecasts we have found that they get into the hands of the district forester or the warden fastest if we hand them over to the main organizations in the province that control the forest production organization. They have their means of communication to their fire control stations, and they pass them along.

Mr. PAYNE: At this time, you feel this service is inadequate?

Mr. MCTAGGART-COWAN: It is less than science would permit us to do.

M. PAYNE: Is it helpful to the industry—or would you describe it as being inadequate?

Mr. MCTAGGART-COWAN: Yes, I think any consensus taken among the industry would say the forecasts we are providing are most useful. They certainly tell us so at the end of each fire season; but we could do a lot more.

Mr. PAYNE: For about $80,000?

Mr. MCTAGGART-COWAN: This was a ball park estimate for the province of British Columbia only. That was for just one team.

Mr. PAYNE: And the money spent through the department for this work is what, today?

Mr. MCTAGGART-COWAN: Our estimates are not broken down that way, so I could not give you a fair answer.

Mr. PAYNE: I am asking you for an estimate, because I cannot decipher it from the estimates. Could you give me an estimate?

Mr. MCTAGGART-COWAN: Not that that would mean anything. We have a forecast office at Vancouver airport. I have not the cost of that with me, but I can provide it to the committee. However, that forecast office provides for the needs of coast-wise and deep sea shipping, aviation, the general public, industry, agriculture and fire. Now, the percentage which you place for each of these activities becomes pretty subjective and pretty arbitrary because it is the same team of men who provide the basic analysis of the weather from which these forecasts come.

Mr. PAYNE: To generalize this, do you feel that the request of the British Columbia lumber associations generally is a reasonable one and, if fulfilled, could fill a most worth while purpose for improving the information?

Mr. MCTAGGART-COWAN: Without any question.

Mr. PAYNE: In regard to fire hazards?

Mr. MCTAGGART-COWAN: Without any question.

Mr. DUMAS: I am sorry, Mr. Chairman, but I have to leave. However, before doing so, I would like to ask Mr. McTaggart-Cowan a few questions. You said, Mr. McTaggart-Cowan, that we had 1,800 rain gauges across the country.

Mr. MCTAGGART-COWAN: Yes.

Mr. DUMAS: Now, where we have those rain gauges, we have at the same time complete or partial meteorological stations where they take the temperature wind directions and so on.

Mr. MCTAGGART-COWAN: Yes. I can give you the actual figures, sir. There are 32 radio sonde stations. Those are the ones that gather the temperature, pressure and humidity up to as near as 100,000 feet as we can get. Then, there are 39 pilot balloon stations that gather the lower level wind patterns only. There are 157 stations that take complete weather observations each hour. They are primarily distributed along your areas. There are a total of 277 stations which take synoptic observations. They are complete observations, taken over six hours, and again communicated by high speed communications. That figure of 277 includes the 157 stations which I mentioned. Then there are 1,020 which take precipitation and temperature measurements twice a day only, and there are a further 515 that take precipitation measurements only.

Mr. DUMAS: Out of those 1,800 rain gauge stations, how many are located, let us say in the southern parts of the provinces, where the population is? Could you give me an approximation of that?

Mr. McTaggart-Cowan: I am sorry I broke it down every other way, but not that way. I have the number for each province but have not the geographic distribution. However, by and large, I would say at least 80 per cent are in the settled parts of Canada.

Mr. Dumas: 80 per cent?

Mr. McTaggart-Cowan: Yes.

Mr. Dumas: Would you tell me how long we have had rain gauges located at the Hudson Bay post in northern Canada?

Mr. McTaggart-Cowan: The initial installation was made around 1860, I think. It was well before the turn of the century.

Mr. Dumas: There are two or three in which I am interested and, at the next meeting, I would like you to give us the date when they were installed. The ones I have in mind are Moose Factory and Attawapiskat, in Ontario; and Rupert House, Eastmain and Fort George in Quebec.

Mr. McTaggart-Cowan: I have not that particular data with me, but I will obtain it.

Mr. Dumas: I know there are some there.

The Chairman: Mr. McTaggart-Cowan, if you would submit that information to me, I will pass it on.

Mr. Dumas: I have another question to ask Mr. McTaggart-Cowan. I suppose included in this figure of 1,800 are all the stations which are operated by the provinces?

Mr. McTaggart-Cowan: Yes.

Mr. Dumas: Fire protection services.

Mr. McTaggart-Cowan: Yes. To the best of our ability, we have cooperative arrangements with all the provinces wherein any observations that are taken regularly are forwarded to us, and we process them.

Now, there are a number of stations which operate for just a few months of the year. For this type of climatic work, they are of very marginal use. They are used in the actual day-to-day forecasting. However, unless you have twelve months of records you cannot process them satistically into your climatic work.

Mr. Dumas: Are you satisfied that we have a sufficient number of these gauges in the southern part of the province?

Mr. McTaggart-Cowan: No.

Mr. Dumas: The population is located in the southern part of the province and, of course, compared to the rest of the country, it is a relatively small area. In view of this, I think it would be better if you took the whole area of Canada, when you are making those calculations.

Mr. McTaggart-Cowan: That is why I put in this column. Those are non-wastelands. We have to make certain broad assumptions as to what is wasteland and what is not. But the non-wasteland area is what we thought was basically capable of supporting the type of community and the activity of life which we have in Canada. This eliminates the tundra, permafrost and muskeg areas.

Mr. Dumas: But it does not exclude the whole of the Northwest Territories?

Mr. McTaggart-Cowan: No. But, even when you do that, you only bring the rain gauge network up to one per thousand square miles, against an international recommendation of one for every 200 square miles. The world meteorological organization has endorsed a recommendation that an adequate sample is obtained if you have one rain gauge per 200 square miles.

Mr. DUMAS: What square mile figure do you use in calculating the wasteland of the country? How many thousand square miles would you say?

Mr. MCTAGGART-COWAN: Point four to one, which means about 60 per cent.

I will table the publication by the world meteorological organization dealing with design of hydrological networks and techniques for surveying surface water resources. This was published a little while ago. I could furnish additional copies, sir, but they are in Geneva, and we have just a few at our headquarters.

Also, I will table, in single copy, various articles which our staff has written over the last few years in regard to fluctuations in the precipitation and temperatures across the country. There are several such publications here.

Also, I have a fly sheet, which gives the number of meteorological stations by provinces. This may be of value to you. If your committee wishes these data broken down in any other way, we can certainly do it.

Sir, the only other thought I wanted to present is our view in respect of what meteorological services are necessary. I think the facts which I have presented show, in relation to other commonwealth countries and other countries which might be considered at similar stages of economic development, that we are seriously undersubscribed. Similarly, in the other research which I included—the pure, applied and basic research—we are very, very undersubscribed, with only three persons spending their full time on this work. If we are to come up with the knowledge and understanding of the meteorological aspects of the water resources in time to be of use to the engineers, an early start would seem to be indicated, because many of these problems are not such that can be solved overnight. There are problems such as the eastern Rockies forest conservation board area, feeding water into the Saskatchewan river, which is probably a ten or twenty year research project. It might produce useable results in a shorter period of time, but you can see from these climatic fluctuations that we are working on a time scale of many years.

I believe that is all I have to say.

The CHAIRMAN: Thank you.

Are there any further questions, gentlemen?

Mr. STEARNS: Ever since Mr. McTaggart-Cowan has been here last week I have been bothered over what he said about putting some kind of alcohol on the surface of a lake to prevent evaporation. Were you speaking of a large body of water or a farmer's farm pool?

Mr. MCTAGGART-COWAN: Basically they would be ponds or small to medium sized reservoirs. Certainly so far as the research in Australia up to the present time has gone, they do not have a method of spreading that kind of film over a large reservoir.

Mr. STEARNS: If you applied that to a farmer's pond could he still raise fish, or would they die for lack of oxygen?

Mr. MCTAGGART-COWAN: The fish would present a problem. I would have to defer to the fisheries experts the question of whether or not there are circumstances which would permit of sufficient interchange between the air and water to support the fish. To the best of my recollection, in the research published to date by Priestley in Australia he has not yet covered that aspect.

The CHAIRMAN: How much wind disturbance would destroy the effect of this substance which is put on the water to prevent evaporation.

Mr. MCTAGGART-COWAN: I think it is ten knots; but it depends on the shape of the pond. If the reservoir is elongated and the wind blows across, it will stand a higher speed than if it blows along it.

The CHAIRMAN: You spoke about the climate becoming progressively warmer in western Canada. What about eastern Canada? Have you any remarks on that?

Mr. MCTAGGART-COWAN: Yes sir. There was a general trend towards warming over several years. There are indications it is levelling off. Whether or not this is a minor fluctuation in a general upward trend, time and further research alone will determine.

Mr. SIMPSON: Could we have a brief explanation of the specific duties of these water observers, we will say at points such as Mr. Dumas mentioned—for instance, Hudson Bay? What statistics do they compile and briefly what are their duties?

Mr. MCTAGGART-COWAN: Perhaps I should start from the simplest type of observing station and work up. At the 515 precipitation gauging stations principally once a day the observer goes out and measures in a glass graduate the amount of precipitation caught in a standard gauge. Generally that is done just once a day. Wherever we can get them to do it twice a day, they do it morning and night. To an increasing extent we plan to convert at least a portion of those stations to automatic rain gauge stations; that is a gauging which not only catches the water but also measures it as it goes through using a clockwork driven drum by which it can be read in terms of millimeters of rain. At the largest group of stations—1,020—they test the temperatures and precipitation twice a day. I should have said that both temperature and precipitation station observers record the results of their observations on a printed form, and at the end of the month mail it in to our collecting centers. That is the extent of their operations.

Getting down to the synoptic stations, of which we have 277, the majority of those are operated by employees of the Department of Transport, either their own experienced and trained meteorological technicians or the radio range operators along the airways who are trained in meteorological operations and perform that function as a supplementary duty. There, the observations take about half an hour every three hours. They are both recorded on a station log, which is sent in at the end of the month and are coded up into a code which is transmitted by radio, teletype or telegram, whichever is available at that station, to main collecting points across the country, and get on to our trunk line communication system. These synoptic observations are exchanged all over the northern hemisphere.

The radio sonde work requires the highest of skills. In this work one deals with what is in effect an elementary form of radar. So the technicians have to have a considerable amount of training. The training for a synoptic observer requires that the person have high school graduation and about four months in a special training school. The radio sonde man takes an additional four months beyond that, or a total of eight months training, and preferably should have something beyond high school matriculation.

The CHAIRMAN: What is the rate of pay for the low skilled category of observers?

Mr. MCTAGGART-COWAN: They are in the $3,000 to $4,000 bracket.

The CHAIRMAN: I am referring to those at the precipitation stations.

Mr. MCTAGGART-COWAN: The majority of those are voluntary. There is a number of them, perhaps one-third, who are given a small honorarium. In recent years, however, practically all the stations we have set up have been manned voluntarily because we found that the person who will do it as a community service in his area on a voluntary basis does a more conscientious and regular job than a person who is doing it for $60 or $80 per year which

we might pay him. So at the present time we only pay this honorarium where we are unable to get a volunteer and feel we must have a rain gauging station.

The CHAIRMAN: Are there any further questions?

Well, gentlemen, I am sure we all appreciate having had Mr. McTaggart-Cowan with us. It has been a most interesting subject, and has greatly stimulated our minds.

I am sure that on behalf of the committee I can express our sincere thanks for the trouble you have gone to, to acquaint us with some of the problems of meteorology.

We will not lose sight of the fact that you seem to be fighting a very uphill battle with a limited amount of money and staff.

Tomorrow we shall have with us Mr. Fox, a well known United States authority on water problems. He will discuss the demand for water in the United States, and its possible effect on Canada. I think this will be of particular interest to almost everyone, and I hope we shall have a good turnout, and all be on time.

We shall meet at 9:30 tomorrow morning in the railway committee room.

Since it is rather late now to start with any new witnesses, I think it would be in order for us to adjourn at this time until 9:30 tomorrow morning.

The committee adjourned.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 5

---

TUESDAY, APRIL 5, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESS:

Mr. Irving K. Fox, Associate Director, Resources for the Future, Inc., Washington, D.C.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22924-5—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, April 5, 1960
(6)

The Standing Committee on Mines, Forests and Waters met at 9.40 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Cadieu, Doucett, Fleming (*Okanagan-Revelstoke*), Godin, Granger, Gundlock, Hicks, Kindt, Korchinski, Leduc, Martel, McFarlane, McQuillan, Payne, Robichaud, and Slogan. (16)

*In attendance:* Mr. Irving K. Fox, Associate Director, Resources for the Future, Inc., Washington, D.C. *From the Department of Northern Affairs and National Resources:* Mr. E. A. Côté, Assistant Deputy Minister; Mr. J. D. McLeod, Chief Enginer, Water Resources Branch, and Dr. K. Kristjanson, Secretary, Advisory Committee on Water Use Policy.

The Committee resumed consideration of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Mr. Fox was introduced and he made an extensive statement regarding the administrative arrangements for River Basin Development in the United States, and was questioned thereon.

During his presentation, Mr. Fox emphasized certain points by referring to a wall map.

The questioning completed, the Chairman thanked the witness for his presentation.

The Chairman announced that it was planned to discuss the Hurricanaw proposal at the next meeting.

At 11.00 a.m., the Committee adjourned until 11.00 a.m. Monday, April 11, 1960.

M. Slack
*Clerk of the Committee.*



22924-5—1½

# EVIDENCE

TUESDAY, April 5, 1960.
9.30 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. I will call the meeting to order. We have with us today Mr. Irving K. Fox.

Mr. Fox is a graduate of the university of Michigan. From 1947 to 1949 he was staff member on the first commission on the organization of the executive branch of the government Hoover commission. From 1949 to 1955 he was with the office of the secretary of the Department of the Interior. In 1949 and 1950 he was located in Albuquerque, New Mexico, assisting in the coordination of all programs of the department of the interior in eight southwestern states. From 1950 to 1955 he was representative of the Department of the Interior on the inter-agency Arkansas-White-Red rivers basin survey. In 1955 he transferred to Resources for the Future Incorporated. He joined the staff in 1955 as research associate, became director of the water resources program in 1958, and is currently associate director of Resources for the Future Incorporated.

I am sure with that background Mr. Fox has a great deal to contribute to the committee, and I welcome him on behalf of the committee.

Mr. Irving K. Fox: (*Associate Director, Resources for the Future, Incorporated*): Thank you, sir.

It is a great honour to be invited to meet with this committee and discuss, as your chairman has asked me to do, the different administrative arrangements which have been utilized for multiple purpose river basin development and management in the United States. I feel that an exchange of experience in the resources field among nations should be profitable, and I believe that we can learn much from one another about institutional and policy matters, as well as about scientific practices. At least, I have been impressed over the years with the possibility of learning from Canadian experience about ways and means of improving resources management in the United States. I am pleased to find that you believe that an understanding of United States' experience with river basin administration will be helpful in proceeding with river basin development in Canada.

In countries as large and varied as the United States and Canada, the problems of river basin development are far from uniform. Moreover, river basin development directly involves different sectors of the national economy including the generation of electric power, agriculture, transportation, recreation, and other things. Therefore, development plans and administrative arrangements involve complex relationships with many industries and are subject to the economic and political forces associated with all sectors of the national economy. Also, the kinds of organization adopted for river basin development and management cannot be disassociated from the total framework of political and economic institutions and the political and economic history responsible for those institutions. Finally, a judgment as to what constitutes an effective system depends upon the goals and objectives sought. People in the United States have seldom been fully united on the goals of river basin development, and these differences underlie much of the debate we have had over organization for river basin development in the United States.

Because of these many complicated factors the objective of my presentation today must be quite limited. In a general way I will describe the different

patterns of administrative organization for river basin development we have used and the reasons for their adoption. I will also outline some of the criticisms that have been made of the various patterns. In conclusion I will examine the forces at work in the United States which may bring about a change in the administrative arrangements now being utilized.

By river basin development I mean both the regulation and control of the flow of streams and the services realized directly therefrom, including navigation, the generation of power, the irrigation and drainage of land, the control of floods, the provision of water supplies for municipal and industrial purposes, the disposal of wastes, the production of fish, and the provision of outdoor recreation opportunities. I recognize that some developments can have a negative effect upon these services. My emphasis throughout will be upon the organization of governmental activities, because river basin development has been primarily a public responsibility in the United States since the early days of the republic. There are, of course, important exceptions. In early times the construction of canals associated with inland waterways was undertaken by private companies. In many communities water for municipal and industrial purposes is supplied by private corporations. One of the more controversial issues in the river basin field in the United States is the question of the extent to which private institutions should be responsible for developing hydroelectric power and associated water services.

The factors primarily responsible for the differences in United States patterns of administrative organization for river basin planning and development can, I believe without too much oversimplification, be reduced to three, namely (1) the structure of the American constitution, (2) the interstate and international character of practically all of the major river basins and (3) certain powerful social drives which have been determinants of natural resources policy.

Our constitution has evolved in a way that gives the national government predominant authority over the states in the development and management of water resources. The original constitution gave the federal government authority over interstate and foreign commerce which meant, of course, authority over navigation. Through court interpretation this provision now means that the federal government has authority to manage the waters which feed the navigable waterways. Including the very small tributaries and streams that are navigable. This authority, together with still other authorities in the constitution, has been further augmented by the fact that the federal government is more able than the states to raise funds. In the early years its financial superiority stemmed from its pre-emption of tariff revenues, whereas in recent times the federal government has largely pre-empted the income tax. Thus an examination of administrative arrangements for river basin development in the United States must recognize the superior legal and financial position of the federal government.

Only in Texas, California and the new state of Alaska are there major river basins which are intrastate in character. To the south we share the resources of the Colorado and the Rio Grande with Mexico. I need not remind the members of this committee of the extent of our common interest with Canada in the basins to the north. International affairs are a responsibilty of the federal government, so that it has a paramount concern with water resources which are international in character. Accordingly, with few exceptions individual states are unable to proceed alone with the unified development of an entire river basin. This fact, combined with its superior legal and financial position, made the federal government the logical political jurisdiction to take the leadership in multiple purpose basin-wide development programs.

The major social drives to which I refer, by determining the timing of public action and the objectives of public policy, had a pronounced effect upon patterns of administration eventually adopted. My associate in Resources for the Future Incorporated, Henry Caulfield, in the course of his current research into federal power policy, has classified these drives into three broad groupings. The first of these he calls the "developmental thrust" which reflects generally a push for economic expansion. This drive has provided much of the impetus for public action in the river basin field. It can be given much of the credit for the development of our system of waterways, the irrigation of millions of acres of land, the installation of vast systems for the generation of hydroelectric power, and reduction of the flood hazard in many of our productive valleys.

During the latter part of the nineteenth century, two other social forces appear to have joined this development thrust and to have modified and reinforced it. Caulfield has called these the "progressive" and "conservation" thrusts.

The progressive thrust was a response to the growth of cities and industry and particularly to increasing concentrations of economic power or monopoly. From the 1870's to well into this century a substantial part of the support for federal navigation projects can be attributed to a desire to regulate allegedly monopolistic rate and discriminatory practices of the railroads through the competition of water transport. In the area of federal hydroelectric power policy it was responsible for the view that the competition of public agencies in the power field was needed to regulate private power enterprises.

The conservation thrust was the reaction of an educated group to the rapid and at times profligate exploitation of our resources during the latter part of the nineteenth century and on into this century. It gave added impetus to the development of hydroelectric power as a means of conserving mineral fuels. It provided the foundation for the soil conservation and watershed management programs of public and private agencies. It offered the belief that through the application of science, resources could be managed in the public interest. It maintained that aesthetic and spiritual values were important considerations in resource management. Of particular interest to us here today, it contributed the intellectual foundation for the concept of comprehensive multiple purpose river basin development.

Turning now to the administrative arrangements we have used for multiple purpose river basin development, I will begin by discussing the role of the state governments. When our federal constitution was adopted the state governments were much stronger relative to the national government than they are today. As the country began to grow and the drive for development got under way, the states took a leading part in the improvement of the nation's waterways. Such important ventures as the Erie canal in New York were sponsored by the states. Large sums were invested in canals and river improvements. However, many of these projects did not pay off in the manner anticipated and some were outright failures. As a consequence, there was a general disillusionment with state investment in internal improvements and public works, with the result that a number of states adopted constitutional amendments preventing or limiting indebtedness for public works including water development. Following this experience, the state governments have been relatively inactive in the water resources field. Only recently has there been a renewed interest in state water resources planning and development. Today, most states have relatively small staffs concerned with investigations, data collection and planning in cooperation with federal agencies. The major exception is the state of California which is engaged in a large-scale planning

and development program. For about 25 years the state of Montana has planned and developed small irrigation projects. Several other western states loan funds to local units for the development of water supplies. A number of states, such as Kansas, have been strengthening their investigative and planning activities. Nevertheless, for the most part public development is dominated by federal agencies which cooperate to a degree with state agencies but which largely work directly with local organizations such as irrigation districts, flood control districts, soil conservation districts and the like.

The state governments have been handicapped by the constitutional and financial factors mentioned earlier and the interstate and international character of the major river basins. They have also been handicapped in other ways. Once the federal government entered the river development field, it offered an alternative to the painful process of raising funds at the state and local level. The possibility of securing federal funds gave a strong incentive to look to Washington instead of to the state capital. Another factor no doubt in the early period was the difficulty of providing a competent engineering staff in every state, whereas the federal government could provide competent service on a centralized basis. Also, a series of scandals in state governments caused a decline in their prestige from which they have not yet fully recovered. Today, still another factor militates against a shift of responsibility to the states in this field. With population concentrating in urban areas and in the absence of reapportionment of state legislatures, state governments have tended to be dominated by the rural areas, whereas most of the people, especially in the eastern part of the United States, live in cities. The result is that the federal congress more nearly reflects popular interests than the state legislatures, and this provides an additional argument for the federal government's retention of its basin development responsibilities.

Let us turn now to the corps of engineers, the first federal agency to assume important responsibilities for river basin development. At the very beginning of the nineteenth century, in response to the irresistible pressure to occupy the country and develop its resources, the federal government became interested in the improvement of waterways for navigation purposes. At that time there was only one important engineering organization in the United States and that was the corps of engineers of the U.S. army. It was quite natural, therefore, that the federal government should turn to the corps of engineers for engineering service in the field of water resources. The programs assigned to the corps were relatively modest until after our civil war when they grew rapidly. And today the annual civil works budget of the corps totals about three quarters of a billion dollars. At the outset the Corps was concerned primarily with navigation. In the post-civil war era it got into flood control in a modest way in the Mississippi valley. Congressional action in 1936 made flood control a nationwide responsibility of the corps of engineers. A series of subsequent legislative enactments has broadened its responsibilities so that its plans now embrace power generation, drainage, irrigation, municipal and industrial water supply and recreation.

Although policy and program direction of corps activities is centered in Washington, planning, development and operating activities are conducted through a system of division—regional—and district offices. Each division directs both the military and civilian program within its region. The boundaries of the region for civil works generally follow river basin lines. A centralized design laboratory is maintained at Vicksburg, Mississippi.

The corps cooperates with other agencies and the states through interagency committees which I will describe more fully a little later. Its districts work closely with local units of government as plans are formulated. The state governments and the other federal agencies are by law given an opportunity

to review and comment on the reports of the corps of engineers before they are submitted to the congress for consideration. The costs of the traditional navigation and flood control programs of the corps are borne almost entirely by the federal government, although local units contribute lands, easements, and rights of way for local flood protection measures. It is of interest that the Department of Interior rather than the corps of engineers markets power from corps installations.

Today the corps dominates public multiple purpose river basin planning and development in practically all of the vast Mississippi river system except in the Tennessee valley, in many other eastern basins, and in the Columbia river basin. It is highly regarded as an engineering organization. It is led by a group of between 200 and 300 of the top graduates of the military academy at West Point and is manned by an unusually competent staff of civilian engineers. In spite of the deserved esteem which it enjoys, it has been the subject of criticism by special study commissions, and independent scholars, as well as others who have subjective reasons for opposing corps programs. It is claimed that at times the corps' interest in construction has blinded its consideration of the economics of proposed projects; that a preoccupation with its traditional responsibilities for flood control and navigation has resulted in inadequate consideration of the other purposes river basin development should serve; that as a unit of the tremendous defense establishment and backed by powerful pressure groups, it has not been fully responsive to the political forces responsible for interpreting the national interest.

The next major federal water resources agency to be established was the bureau of reclamation. It came into being in 1902 in response to the drive to develop the arid West. Initially its only concern was the irrigation of arid lands, so its operations were limited to the seventeen western states deficient in moisture for the normal cultivation of crops.

This begins with Texas, you might say, and goes north to North Dakota. This, as shown on the map, is the area served by the bureau of reclamation. Its responsibilities were gradually expanded so that power, flood control, municipal and industrial water supply and revreation could be covered by its projects.

The bureau is a unit of the Department of the Interior, which in some ways is the principal natural resources agency of the federal government. General direction of policy and program is provided by the commissioner's office in Washington, but planning, development, and operating activities are conducted through regional and district or area offices. Regional boundaries follow river basin lines. A centralized laboratory and design office is maintained in Denver.

At the field level it functions in much the same way as the corps, co-operating with other agencies through interagency committees and working closely with local units of government. In contrast with the corps it markets hydroelectric power from its own installations and for its traditional function, irrigation, the water users are required to sign repayment contracts covering all operation and mainteance costs and a portion of all other costs. However, the extent of the federal subsidy has increased substantially over the years.

The bureau has been subject to some of the same criticisms as the corps: overemphasis on construction of projects, a preoccupation with traditional responsibilities—in this case irrigation—and an alignment with powerful special interest groups. Possibly because of its location in the Department of the Interior where it is a principal concern of a cabinet member responsible for implementing administration policy, the bureau seems to have gotten more deeply involved in ideological controversies than the corps of engineers. In

any event, at least twice in its history it has been deeply involved in such controversies, once over the question of whether federal irrigation projects should limit the provision of water supplies to "family size" farms—this is the 160-acre limitation that we have under the irrigation law—and the other over the development and marketing of hydroelectric power. Now we will turn to the TVA.

In 1933 congress established the Tennessee valley authority after more than a decade of untiring effort by Senator Norris of Nebraska. The TVA was the product of many forces. It was a response to the view given expression by the conservation movement that river development should be undertaken on a mutliple purpose basin-wide basis. It also reflected the conviction of Senator Norris and of the progressive movement generally that the satisfactory regulation of the electric power industry could only be achieved through governmental competition. Finally, the TVA was a product of the depression and therefore was looked on as an instrument to improve the economic well being of a major depressed area of the nation. Governed by a board of directors responsible to the president, it was free to chart its own course without regard to the commitments and traditions of the established water agencies. It was relatively free to function in the entire field of natural resources and agriculture.

The record of the TVA is widely known throughout the world. Many consider it to be one of the major accomplishments of the new deal. Few have questioned the efficiency of its operation. Many have acclaimed the way in which it used the authority and resources at its disposal to improve the economy of the valley. The close working relationships it established with local and state agencies and the manner in which it has co-operated with them has, I believe, served to strengthen state and local units of governments instead of weaken them. In no other river basin in the United States has there been an equal degree of unity in planning, developing and managing the water resources of a major basin, and an equal degree of co-ordination of water development with related natural resources programs.

Although the Tennessee valley authority enjoys excellent support from the people of the basin, no other administrative arrangement for river basin administration in the United States has been so widely and so violently opposed. There have been four major kinds of opposition to extension of the valley authority approach to other basins. First, there were those who saw in TVA an unwarranted intervention in the field of electric power generation, a field generally considered to be the responsibility of private enterprise. The concern of the electric power industry was further aggravated when, after the hydro was about fully developed, TVA was authorized to engage in the generation of thermal electric power, with the result that now thermal generation exceeds hydro. Thus, to some the valley authority is equated with a public power agency. Second, the valley authority has been opposed on the grounds that it is a threat to state governments, that it assumes responsibilities that normally should be discharged by the states. Third, it has been opposed by the established natural resources agencies and their adherents, who saw in the valley authority concept a threat to their own programs and responsibilities. Fourth, there were those who believed that the establishment of valley authorities in other basins would create serious administrative problems for the federal government. The concern was that with a number of valley authorities operating there would be a need for co-ordination of their policies and programs at the Washington level. Those who held this view generally supported combining the corps of engineers and the bureau of reclamation into a single agency having regional branches organized by river basins.

As the example of the TVA stimulated interest in river basin development in general, there was widespread support for the establishment of other valley authorities. But opposition to the valley authority approach was strong enough to prevent the establishment of an authority in any other basin in the United States. Nevertheless, it had become widely accepted that a greater degree of unity in river basin planning, development and management than had been achieved in most basins was needed. Thus, beginning immediately after World War II, committees to co-ordinate the river basin programs of the various federal agencies with one another and with the states were established in the major river basin areas of the country. Such interagency committees now operate in the Missouri basin; in the Pacific southwest which includes the Colorado basin, the great basin which drains into Salt lake, and most of California; the Columbia basin; and the New England area. These committees have been established through voluntary interagency agreement. However, a special interagency commission has been established by law to plan the development of the Gulf coast streams of Texas. A similar special commission has been established for several basins of the southeast covering all of Georgia, part of South Carolina, part of Alabama and part of Florida.

That is this area right down at the point I indicate. It does not include the Rio Grande, which is an international stream, or the Sabine, an interstate river. There is another area covering this part, from here to here—of Georgia, a little of Alabama, a little of South Carolina and a little of Florida. There are two of these special interagency commissions. These commissions are quite similar to the interagency committees except that they are established by statute, they have a specific task to perform, namely, to formulate a plan of development, and they have a chairman appointed by the President who does not represent any one of the participating agencies.

The functions of the interagency committees and commissions can be characterized best by emphasizing that they are coordinating bodies. The existence of the committees in no way alters the functions and responsibilities of existing agencies or the states. They are a clearing house for exchange of information and for the establishment of procedures to assure the coordination of programs. I was closely associated with one of the interagency committees for about five years. My view is that as a coordinating device they serve a useful purpose. At the same time one must recognize the limitations under which they operate. If there are important policy differences among the agencies, such differences can only be settled by the Washington headquarters of the agencies and cannot be settled in the field. In my own experience, this was a serious handicap. The existence of the interagency committee does not alter or greatly change the operation of the established agency. It facilitates an exchange of information; it provides a medium for joint effort. But whatever the limitations of the participating agencies may be, they remain unchanged by the existence of the interagency committee. We have not had enough experience with the interagency commissions—which have an independent chairman—to assess their effectiveness. On the one hand, since the authorities and responsibilities of the regular agencies remain unchanged, no major change in approach should be anticipated. On the other hand, an independent chairman may provide an over-all view of basin problems which cannot be expected from the individual agencies. He may also moderate the differences that arise among the agencies and thus secure a greater degree of program integration than might otherwise be achieved.

The Department of Agriculture has been engaged in river basin work since 1936. As the program has evolved under the most recent legislation, the soil conservation service of the Department of Agriculture provides technical assistance and federal subsidies for multiple purpose development of relatively

small watershed areas (under 250,000 acres). Under this program measures for water flow retardation through land treatment are coordinated with water storage for a variety of purposes including irrigation, flood control, municipal water supply and recreation. Actually, for the projects undertaken so far, the overwhelming proportion of the benefits attributed to the projects are for flood control. This result is no doubt related to the fact that the costs of flood control are borne entirely by the federal government.

In carrying out the program offices of the soil conservation service in each state work through local districts organized under state law. Technical assistance to SCS state offices is provided through offices located in various regions over the country. Plans for development must be approved by the state government.

The program has been widely acclaimed because it gives attention to a portion of each basin generally neglected by the other water development agencies and because of its emphasis upon state and local participation. There are some who question whether local participation is very significant in view of the extent of the federal subsidy, and the fact that most of the technical work is done by the soil conservation service. The program has posed some problems of coordination with other federal agencies planning multiple purpose river basin works for entire river basins of which the small watersheds are a minor part. Since the upstream measures influence the hydrology of the basin to some degree, there is a concern, particularly in western areas, that such upstream programs may reduce the total supply of water available for use or at least alter the location at which it is utilized. Such hydrologic influences also affect flood flows and thus affect basin-wide planning for flood control.

Another important recent administrative arrangement has been the initiation of a grant-in-aid program by the federal government to municipalities for the purpose of helping them build sewage treatment works and thus reduce pollution. This program has received widespread support but it has been opposed by the administration in the belief that waste treatment should be the responsibility of local communities. Nevertheless, it is a significant step because it is the first important instance in which the grant-in-aid technique, that is widely used for other purposes by the federal government, has been applied in the water resources field.

In view of our varied experience, where are we heading with regard to the organization of our river basin activities? It is only realistic to recognize that existing arrangements are well established and that the resistance to change will be great. The corps of engineers has been engaged in water development for 130 years and the bureau of reclamation has been so engaged for nearly 60 years. They have long traditions and articulate and well organized supporters so that significant changes in the scope of their responsibilities do not appear likely. Even TVA, whose future seemed uncertain a few years ago, now seems firmly established. Similarly, the relations between the state and federal government which have evolved over a period of 170 years will not be easily altered. I am reminded of a statement of Maeterlinck in which he said:

> At every crossway on the road that leads to the future, each progressive spirit is opposed by a thousand men appointed to guard the past. Let us have no fear lest the fair towers of former days be sufficiently defended.

Nevertheless, there have been powerful influences at work since World War II which could modify existing patterns in a significant way. Among these influences I would include the following:

1. The tremendous increase in demand for water development and the radical change in the nature of demand upon our water re-

sources. This influence stems from the rapid growth of our population, the rapid rate of urbanization, the rapid growth of our economy, and the general improvement in economic well being. These factors, when combined, foreshadow an enormous increase in water demand in the future. Of paramount importance, our studies suggest that two kinds of demand will dominate future river basin development in much of the United States. One is the use of water for recreation purposes; the other is the use of water to carry away the wastes of cities and industries. The traditional purposes will remain important but they will be subordinate to these overriding considerations.

I want to refer now to this map I have here. I tried to portray—I hope you can see it—what are, you might say, the flows of our water resources. The green is the average annual run-off in the major river basins. For instance, this is for the whole southeast, this is for the Arkansas White-Red, this one covers the Tennessee and the Ohio. So the green represents the kind of flows we have for use. The orange in each case represents the amount drawn off for irrigation, for municipal and industrial purposes. The black in each case indicates the amount that is not returned to the watercourse but disappears largely into the atmosphere.

I think you will see a rather interesting situation here. You see that we have lots of water in the eastern part of the United States for withdrawal purposes and throughout practically all of the east we will not experience shortages of water, in my judgment, to meet the irrigation, municipal and industrial requirements. The influence that will be controlling in water development over much of that area will be the demands for dilution flows, dilution of waste, for preserving areas for recreation purposes, and these will tend to dominate the character of development.

Now, in the west, very roughly from about here, westward, there is a somewhat different situation, except in certain portions of the Columbia river basin. You can see in the Colorado great basin, this vast region through here, where the precipitation run-off is very, very slow, that the withdrawals today are exceeding the average annual run-off and the net consumption of this is about two-thirds of the average annual run-off. Here, I think, over the years we are going to have to make some major adjustments in water use because of the extent of gradual consumption. I am sure you are well aware, or you have heard that in large areas of Arizona we are lowering the water table at a very serious rate. This is also true in areas like this, as well as other areas of the west. I can come back to that if you want to later.

2. The impact of science and technology on water use. Science and technology influence water use in many ways. On the one hand, industrial processes have multiplied the demand for water in industry. At the same time, technology offers the promise of reducing demand where supplies are scarce or costly and increasing the supply through such measures as desalinization and weather modification. My own estimate of the situation is that for most of the United States water shortages pose no serious threat if we take full advantage of the potentials which technology and science have to offer.

3. The increasing complexity of the task of designing suitable multiple purpose river basin systems. This will result in part from the increase in intensity of the competition for land and water. It will be more and more difficult to find reservoir sites which are

not already occupied. This will be more particularly noticeable in the densely populated eastern areas. Because of the growth in water demand differences over the way to use the resource can be expected to sharpen. Moreover, an affluent, urban-industrial society will place less weight upon monetary values and more upon intangible values such as scenic considerations, which will increase the difficulty of making a choice among alternatives.

4. The growing competition for federal funds. All signs point toward a greater and greater demand upon the federal treasury for education, for a variety of social programs, for urban renewal, for foreign aid, and for defense, with the result that more of the gross national product may be expended by government in the future than in the past. The net effect could be that federal appropriations for capital investments in water development will be more difficult to secure than in the past, while at the same time capital requirements will multiply.

5. The prospect that the responsibilities of the federal government will continue to multiply. The United States has a preoccupation with world affairs unknown prior to World War II. Our international responsibilities will no doubt continue to place a heavy burden upon the federal treasury. They also place a heavy burden on members of congress and officials of the executive branch. To this burden must be added the new responsibilities which the federal government is assuming in areas of education, urban renewal, and social security. With the task of the congressman and the federal official becoming ever larger, the need to decentralize in one way or another becomes ever more imperative.

A relative assessment of these many influences suggests the likelihood of a moderate amount of change to meet the situation which now confronts us. Certainly in some of the major river basins existing agencies will continue to dominate the scene. This will be true in the Tennessee valley where TVA now seems well established. It will also be true in the Colorado, the Ohio, the Arkansas, the Missouri, the main stem of the Mississippi and some other areas where either the corps of engineers or the bureau of reclamation or both combined have established programs.

It seems reasonable to expect pressure to mount to experiment with new administrative arrangements in areas where the existing agencies are not so well established. This will be particularly true in the area east of the Mississippi river. Evidence of this likelihood already exists. Thus today a serious effort is being made to establish through federal-interstate agreement an independent river basin agency for the Delaware river basin.

I believe you may know or are aware that is a relatively small basin, I think 11,000 or 12,000 square miles, right up through here covering part of New York, Pennsylvania, Delaware and New Jersey. It serves a very dense population of course, including part of the water supply of New York City.

A local group under local sponsorship is conducting its own study of the Meramec basin near St. Louis in Missouri. Recently, Illinois and Indiana made a compact which provides for cooperative planning through a special commission for development of the Wabash river basin, which is on the Ohio. It is also significant that the state of California has undertaken on its own initiative a large-scale water development program.

The pressure to expirement with decentralized administrative arrangements might conceivably be reinforced if the federal policy were modified

so as to provide an environment in which such experiments might flourish. In particular, if the federal government would make subsidies available to state and regional agencies on the same basis that such subsidies are available through the corps of engineers, the bureau of reclamation and the soil conservation service, such agencies would be in a better position to compete in basins where the large existing agencies do not have programs well along. A federal development loan fund from which state and regional agencies could obtain loans would also encourage further experimentation. Both ideas are being seriously discussed. Such measures promise several advantages. They would reduce the burden upon congress and the executive branch, which stems from consideration of individual projects. Although federal subsidies may continue to be large, it would be reasonable to expect state and regional agencies to secure part of their capital elsewhere, such as the bond market, which TVA is now doing, and thus reduce in some measure the pressure on the federal budget.

In short, we should anticipate a continuation of a pluralistic approach to water resources administration in the United States. The corps of engineers and the bureau of reclamation will no doubt continue to operate over large areas. The TVA seems well established. The soil conservation service has widespread support for its small watershed programs. Interagency committees, possibly strengthened in the form of interagency commissions, will, no doubt continue to function. New regional agencies may enter the field, such as in the Delaware, in California and the Wabash. Conceivably the federal government will foster the establishment of such agencies through the extension of the grant-in-aid technique and the establishment of a loan fund.

Well, that is pretty much my story. I do not know what its implications are for Canada. However, in view of the tremendous water development potential which Canada enjoys, and in view of the population and economic growth which certainly lies before you, it seems evident that you will have a large expansion of water development in the years ahead. If our experience in the United States is any guide, you will be adapting your institutions, your laws, your federal-provincial relations, the organization and function of your government agencies so that they may deal ever more effectively with the problems and needs of water development during the exciting decades ahead.

I have talked quite a bit about water and I would like to read to you a little statement about it that comes from the *Philadelphia Monthly Magazine* of 1798:

> By its fluidity and mildness (pure water) promotes a free and equable circulation of the blood and humours through all the vessels of the body,...hence water-drinkers are not only the most active and nimble, but also the most cheerful and springly of all people.... But to delicate and cold constitutions, and to persons unaccustomed to it, water without wine is a very unproper drink.

Thank you.

The CHAIRMAN: Thank you very much, Mr. Fox. I am sure that your very comprehensive review of the water resources and water developments in the United States has provoked a good deal of thought, and I hope some questions from the committee.

Mr. HICKS: I would like to ask, Mr. Chairman, if there are any fish problems in connection with the water control that you have mentioned as opposed to flood control and hydro dams?

Mr. FOX: We certainly have a great many of them, sir, in the United States. Some, I am sure, are associated with Canada. As you possibly are

well aware, the Columbia river basin is the one that has received the most attention, and I imagine you have heard a little bit of the fireworks that have taken place out there. At the moment in the Snake river basin, there is a site on the Snake river at Nez Perce which will not likely be developed for some years, because it would cut off the Salmon river and eliminate part of the spawning grounds, and the dam would be so high that the fish could not get over it. Over the years the salmon problem, as it is related to hydro-electric power development in the Columbia, has been one of the major issues in the Columbia basin. Probably you have heard of a book published in the United States called *Fish Versus Dams* which arose out of the Columbia river basin situation.

In other parts of the country there are more and different kinds of problems. Take, for example, in the Chesapeake bay near Washington—this is covered up on this map—the pollution that is going into the streams affects the shell-fish and the oysters. This is also true along here in the gulf of Mexico, the shellfish industry has been adversely affected. So although federally the construction of dams has made it a difficult problem for anadromous fish to get upstream, pollution has affected the shellfish.

There have been other influences in other waters. In other parts of the country where there is relatively little water the provision of the dams has meant great opportunities for people to go fishing and engage in outdoor recreation. There is a very interesting little development in Arkansas. They are developing some water supplies for irrigation of rice lands. But they have to have a rotation of the crops—they cannot plant rice every year. So they plant fish every other year and raise fish on the rice paddies, and market the fish through a cooperative. These are some of the ramifications.

Mr. Hicks: Is there a committee working on the program of trying to get salmon up over some of these high dams?

Mr. Fox: In the Columbia river basin, the Columbia basin interagency committee, has given this quite a bit of attention; and the United States fish and wildlife service has been engaged in research on this. My friends in the fish and game industry in the United States tell me that we are not investing anywhere near the amount we should in that sort of research. There are others who think we are investing as much as we can afford. So you will have that difference of opinion.

Mr. Hicks: Thank you very much.

Mr. Fleming (*Okanagan-Revelstoke*): It is correct, is it not, that the conflict is largely with the commercial fishing waters? Sports fishing waters as a rule generally appear to be increasing, whereas commercial fishing water containing salmon and similar fish are less; and the commercial fishermen are the ones who are impeded by these large-scale developments?

Mr. Fox: This is not entirely true. I worked in the basin I now indicate for five years. There has been a fair amount of reservoir development and there are some new reservoirs being planned. The problem we got into down there was, we had lots of lake fish compared to the amount of population, because of the dams being built. But the construction project proposed would take the last fishing streams, and stream fishing was going to be destroyed. We would not have any more stream fishing in that area. So it does things to an area. There has been a lot of discussion over this stream fishing. Otherwise, your point is well taken.

Mr. Fleming (*Okanagan-Revelstoke*): Did I understand Mr. Fox to say that under the American constitution relating to rights to water as a resource,

that it did lie with the states; and then it was a matter of time where the authority gradually shifted to the federal government rather than the state government?

Mr. Fox: I think when you get to the question, of you might say, the ownership of the resources, from the outset the federal government had control over the regulation of navigation, which was interpreted to mean the regulation of navigable streams and waters.

Now, this has been interpreted by the United States Supreme Court. The federal authority has been gradually expanded, and if you will ask a good many people in the United States today they will say the unfortunate thing is we do not know who has control over the water, in view of the way this interpretation has gradually taken place.

Beginning in the 1870's, with the enactment of legislation relating to the irrigation of arid lands and the disposal of the western lands, the federal laws generally have stated that the states will have responsibility for the location of property rights on the water for these purposes, except that always that allocation must be subordinate to the federal authority over navigation. In the most recent decision, called the Kelton dam decision, which is being debated very heavily at the present time, the federal government authorized the construction of a dam, and the courts held that the power company which wanted to build the dam did not need to get the approval of the state. The state insisted that there should be state approval because it affected water rights that it had granted.

There is a rather complicated bit of reasoning here, that since this involved publicly-owned lands, the federal government said this was a federal decision and there was no need to comply with the state decision. Right now there is a great deal of interest in the Congress in repealing the Kelton dam decision, to clarify it.

I would say the allocation of water for municipal, irrigation, industrial and recreational purposes is a state responsibility and that the federal government is always in a position to move in where navigation is involved.

The point I was making was that initially, under the constitution and the way things were done, the states took a large share of the responsibility for actual development of the water resources. In the Mississippi valley, state and local districts provided flood control. The states originally provided much of the navigation facilities through the canals and the connecting waterways. But gradually, beginning in the 1870's, the federal government moved in, to the Mississippi, helping with flood control and improvement of navigation; and out of this whole situation has developed what we have today,—you might say a relatively clear federal domination of authority.

The CHAIRMAN: I wonder, Mr. Fox, if you would briefly tell us what the Supreme Court's interpretation of the term "navigable waters" involves?

Mr. Fox: I am not a lawyer and I am afraid I cannot do this very well, but I will try to explain. If I remember—and I have not reviewed this recently—this authority over navigation has been expanded so as to authorize the construction of small reservoirs, the provision of water flow retarding measures like treatment of water on the lands, anything that affects the flow of a navigable waterway. So that almost from the time that the rain begins to fall, on down, the federal government, under the constitution and its practical interpretation is in control. I think I am not exaggerating.

Mr. PAYNE: It seems to me one of the greatest difficulties in superimposing the United States picture on the Canadian scene is the fact that, although they have separate states, other than for criminal law purposes they are not respected on the same basis by the federal authority as the provincial governments are in this country.

Mr. Fox: I do not belive I am in a position to comment on that. I would be the first to say that your system should be to proceed in accordance with your own institutions and your own needs. It is probably very difficult just to look at what somebody else has done, and try to adopt it wholesale.

Right now we are considering in our own research program, in Resources for the Future, experiences around the world that we might consider in improving our own policies and practices in the United States. But I think we have recognized in our work that we will have to look hard at them. We might be able to gain some information; but because of the nature of our own institutions and the way they have evolved, we will certainly take them into account in making any adaptation we possibly can.

Mr. Payne: There is one question I should like Mr. Fox to deal with and that is the ocean flow inland from the California coast, I believe, to the Colorado area where there is a deficiency of run-off. What is your proposed approach there to the problems you face in that area? How do you intend to increase them?

Mr. Fox: Well, this is a tough one. I do not think it can be met by any simple single sort of answer. As you no doubt know, the congressmen and senators from that area are greatly interested in desalinization, not only of sea water but of large areas of brackish water in these states. As you are well aware, desalinization is still pretty costly and, barring a major technological breakthrough that we do not now foresee, it is not going to be useful in meeting a very large proportion of the demand.

It may be useful to this extent: when you get down below this irrigated area, down here the water has been used and reused so many times that it has become brackish. There are 200,000 or 300,000 acre fields in the Rio Grande area that are not usable because the salt content has increased to maybe 2,500 or 3,000 parts per million. Sea water, by comparison has 35,000 parts per million or something like that. This water can be desalinated at a cost of very close to being economical,—say, 30 cents a thousand gallons, or thereabouts. So one of the things that will probably be done eventually will be to desalinate some of the brackish water, and this may come about very soon. This is one measure.

There is a great deal of water consumed in that area today, the southwest, by what the people call phreatophytes—water-loving plants. In this area where I work the growth of the salt cedar above this reservoir at Elephant Butte, right here, consumes almost as much as irrigation. A major program, I feel, will no doubt be undertaken to reduce the consumption of water by this water-loving plant. The salt cedar is an exotic. It came from the Far East. It was brought in as a decorative shrub, has invaded the whole area, and is causing a tremendous amount of lost water.

Another thing that will likely be done is the adoption of certain measures to reduce evaporation. You have probably heard of the one molecule layer of film being experimented with, to put over reservoirs and thus eliminate or reduce the evaporation from the reservoir. In this area the evaporation over a year will be from six feet to eight feet deep over the reservoir area, and that is quite a large amount of water in a large reservoir.

A fourth thing is the improvement of irrigation practices. We are very wasteful today in the way we use water for irrigation. This is in part attributable to the nature of our water irrigation laws and in part it is due to a lack of knowledge of good irrigation practices. We may use as much as twice what we should use in many of these basins.

I think there is also a final thing that no doubt will be done—well, it is being done and no doubt will be done more. That will be an adjustment in the use of water from irrigation to municipal and industrial purposes. When I lived in

Albuquerque in 1950 it was about 100,000. It is moving on up to something over 250,000 today. Phoenix has grown very rapidly, and there is a certain amount of indutry coming in there. It will support a great many more people with a much smaller amount of use, you might say, than irrigation.

Just look at the figures here. Here is the consumption in these heavily populated eastern areas. You can see how it compares with the consumption in this area I now indicate. So that a great increase in population and economic industry can be put in that area, and supported through some adjustment in industry or adjustment from agriculture to industry in the use of water supply.

I think this combination of things will probably occur. I do not anticipate that growth will really be retarded in the southwest because of a lack of water. I think that area is destined to grow rapidly, and that those adjustments will come about one way or another.

Mr. SLOGAN: I would like to ask Mr. Fox if he knows anything about the program the United States is following on the Red river, below the border. Is that a federal or state program? I think you are building some reservoirs, doing some dredging and so on.

Mr. FOX: I am not very familiar with that area, I am sorry to say.

Mr. SLOGAN: Another question I would like to ask, Mr. Fox. I suppose you are familiar with the proposed plans for the development of the Columbia river?

Mr. FOX: Yes.

Mr. SLOGAN: I was wondering what your opinions were regarding the Libby dam?

Mr. FOX: I was told this was not a subject which would be discussed here.

The CHAIRMAN: I think, Mr. Slogan, we had better stay away from that for the moment, because of the negotiations that are being conducted. I think it would be most unfair to ask anybody to express an opinion, especially an American citizen.

Mr. LEDUC: Would you tell me if you have in the United States many pipelines drawing water for consumption from long distances, mostly by gravity or pump, for water supplies to cities?

Mr. FOX: Yes, we do have a number. I am sure I am not familiar with all of them but I will mention a few. A good share of the water for southern California is drawn from the Colorado river, and water is taken through a large pipeline for a couple of hundred miles. There are people who say it should not have been done, that it is more costly than was justified, and so on. The fact remains that this was a major engineering work. Through a system of pumps water was brought up over the hills and into the rapidly expanding metropolitan areas. In fact, there is enough capacity in that pipeline so that the growth of the Los Angeles area for a number of years can be taken care of from this source, provided the argument between Arizona and California as to who is entitled to that water proves to be in favour of California.

Now, as far as I am aware—I am sorry, my map is covered up here—but New York City goes to the Delaware basin for water and it goes right over into this area. New York City is down in here. Again, something over 100 miles odd, it brings water from the Delaware basin into the Hudson basin, down to New York City.

Mr. LEDUC: It is mostly pumped?

Mr. FOX: Yes, it has to be there, at least. There is some pumping.

Mr. LEDUC: If you had a gravity, we will say, of 300 or 400 for it you would not need any pump, and that would be much more economical?

Mr. FOX: Well, in fact, if you have enough of a drop, you could use power in the process. This is in fact done in the Colorado basin. They bring the

water through a tunnel in the mountains from a relatively high elevation on the western side of the continental divide. It drops down, I think, a couple of thousand feet and they produce quite a large amount of power with a relatively small amount of water.

Mr. MARTEL: Mr. Fox, one question. From your lecture and from the map there seems to be two, what you might call, water agencies or federal agencies along the Great Lakes, around lakes Michigan, Superior and Huron and there seems to be another one inland starting from, say, South Dakota, which is rose coloured. My question is, I wonder if it comes from either agency, the water diversion we have heard so much about from lake Michigan.

Mr. FOX: Chicago?

Mr. MARTEL: Yes.

Mr. FOX: Well, let me explain. I should have clarified this as far as the map is concerned. There is not a separate agency for each of these different colours. The map purports to illustrate where the drainage is. It has been put out by the United States geological survey. This drainage is to the Great Lakes, the green, this is the Mississippi, and so on.

In the case of the diversion from the Great Lakes into Illinois, and out of it into the Mississippi, this has been something where the responsibility has been rather carefully distributed among a number of authorities, maybe to avoid pinning it on anybody. What happened was that this question of how much diversion, and so on, was brought before the Supreme Court, and the Supreme Court has, you might say, taken on itself the decision as to how much water could be diverted from the Great Lakes into the Illinois river.

Now, the corps of engineers has actually been responsible for most of the multiple purpose planning in this whole area, through here. But under that particular decision the United States Supreme Court took jurisdiction because of the fact that within the United States it affected a good many different states, and under the constitution differences between states have to be handled by the Supreme Court.

Mr. MARTEL: It would also involve an international agreement.

Mr. FOX: It certainly does, yes.

Mr. MARTEL: I understand there have been new discussions quite recently about this action. I would like to know if, as you say, it does not come under the responsibility of any one particular agency, and whether there are many other state or federal agencies responsible?

Mr. FOX: Right.

Mr. MARTEL: Would either the federal or some other agency that would be responsible for that be prepared to buy water—let us say if an international agreement had been reached to buy a certain quantity of water for actual diversion?

Mr. FOX: Well, first let me make a distinction here—

The CHAIRMAN: I do not think you were really expected to give an answer to that question, Mr. Fox, but you could perhaps express an opinion.

Mr. FOX: I think there is probably an international legal question here that I am not at all qualified to answer. The other thing that I would say is that there is, of course, interest on both sides of the border in preserving lake levels and so on in the Great Lakes. I think probably, through time, there is going to be some solution worked out because of the pressures on both sides.

Mr. MARTEL: I agree.

Mr. KORCHINSKI: I was wondering whether there has been much work done in re-diverting the flow of water from one river into another to control

flooding, and what success you have had. Perhaps you can deal with it in relation to damming, diking, and so on. Now, the other question I want to ask is whether you had any instances of reversing the flow of a river by diking and raising the height?

Mr. Fox: Well, to reply to the first question, as to whether we have used diversion of the flow as a means of reducing floods, I do not know that we have done this in a major way, except through what we call floodways. You probably cannot see it up here on the map; but as you know the Mississippi often gets on the rampage. It has been difficult for us to manage, and has established and dominated much of our policy in this whole river basin. There are ways of diverting the Mississippi over into some auxiliary channels. There is a stream over here called the Atchafalaya which almost parallels the Mississippi. A good share of the Mississippi river, when it is at high flood, is diverted into the Atchafalaya and a great deal of it down here is diverted into lake Pontchartrain. These are very important for flood control, although they are not moving the floods into another basin. It is still part of the delta area of the Mississippi. There may be other examples I cannot immediately think of.

I cannot think of any cases of actually reversing the flow of the stream except we do have, you know, a number of these transcontinental divide diversions where the water is impounded on one side of the divide. Here it goes down into the Colorado and by moving the water through the mountains, or over the mountains in one way or another, it can be made to flow into the Arkansas. There are several of these in the Denver area right now, and there is another one down here in the upper Arkansas that is being discussed. In fact, the plans have been finalized and now lie before Congress.

Mr. Korchinski: This is by means of pumping through tunnels, and so on.

Mr. Fox: Let us take one that I have visited. Just here there is an impoundment of the upper Colorado river, the basin there, into a lake. The water is pumped actually up, say a hundred feet into another lake. This lake, then, has a tunnel level out through the mountains. In fact, it goes right between Rocky Mountain National Park, north of Denver, comes out on the other side and drops down a couple of thousand feet into the valley there, goes through a series of drops and supplies water for irrigation, municipal and industrial purposes on the other side of the divide. So although there is some lifting up, most of it is really a drop. The drop is much, much greater than the amount of the lift. This was just a convenient place to put it through the mountains.

The Chairman: Mr. Fox, are you familiar enough with the water resources of Canada to express an opinion as to where you think we might be facing some major problems.

Mr. Fox: I would hesitate, sir, very much to do that. I do not feel I am competent.

The Chairman: Well, gentlemen, this committee room is required for another committee in a few moments. I think we have all enjoyed and learned a great deal from Mr. Fox's appearance here. And on behalf of the committee I want to express my thanks to him.

On Monday, gentlemen, we will plan on a discussion at the request of several members of the committee on the Hurricanaw proposal. Would those who are particularly interested kindly get in touch with me.

Mr. Payne: We did not hear your announcement.

The Chairman: On Monday we plan to discuss the Hurricanaw proposal which was suggested by Mr. Mitchell and Mr. Martel a few meetings ago. We would like them to get in touch with me as quickly as possible so that we may arrange the planning of our next meeting.

That will be all, gentlemen, until next Monday at 11:00 o'clock.

The committee adjourned.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

## MINUTES OF PROCEEDINGS AND EVIDENCE
No. 6

MONDAY, APRIL 11, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESSES:

Mr. Thomas W. Kierans, Engineer, Rockiron Co. Ltd., Sudbury, Ontario; Dr. Kenneth Hare, Professor of Geography, McGill University; Mr. Robert Evans, Sudbury *Daily Star*, Sudbury, Ontario; Mr. A. E. Côté, Assistant Deputy Minister, Department of Northern Affairs and National Resources.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22948-4—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, April 11, 1960.
(7)

The Standing Committee on Mines, Forests and Waters met at 11.00 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Cadieu, Doucett, Dumas, Fleming, (*Okanagan-Revelstoke*), Godin, Granger, Hicks, Korchinski, MacRae, Martel, McFarlane, McGregor, McQuillan, Mitchell, Payne, Robichaud, Simpson, and Stearns. (19)

*In attendance:* Messrs. Thomas W. Kierans, Engineer, Rockiron Co. Ltd., Sudbury, Ontario; Dr. Kenneth Hare, Professor of Geography, McGill University; Robert Evans, Sudbury Daily Star, Sudbury, Ontario. *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister, and J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman announced at the request of Mr. Mitchell, the Steering Committee agreed to recommend that Messrs. Thomas A. Kierans, Robert Evans and Kenneth Hare be called to appear before the Committee on Monday, April 11, to discuss the Harricanaw River project.

On motion of Mr. Mitchell, seconded by Mr. Godin,

*Resolved,*—That Messrs. Thomas W. Kierans, Robert Evans and Kenneth Hare be called to appear before the Standing Committee on Mines, Forests and Waters on Aprill 11, 1960, and that the Committee pay their reasonable travelling and living expenses.

The Chairman introduced Messrs. Kierans, Evans and Hare and then called Mr. Kierans.

Mr. Kierans distributed a document to the committee dealing with his proposal for a James Bay Waters Reclamation Project, made a statement thereon and was questioned.

The witness tabled a letter he addressed to the Honourable Alvin Hamilton, Minister of Northern Affairs and National Resources dealing with his proposal. It was agreed that this letter be included in the record of this day's evidence together with Mr. Hamilton's reply which was read to the Committee by the witness.

During his presentation, Mr. Kierans emphasized various points by referring to a wall map.

Questioning of Mr. Kierans concluded, the Chairman then called Dr. Hare who made a statement dealing with Mr. Kieran's proposal, was questioned thereon and then retired.

Mr. Côté explained the ownership of waters and legislative authority over their uses.



22948-4—1½

Mr. Evans was then called and questioned. He referred to conversations he had with members of the United States Congress and then read a telegram which he received from Senator Alexander Wiley of the United States Senate referring to Mr. Kieran's proposal.

Questioning concluded, Mr. Evans was retired.

*Agreed,*—That the following motion, which was moved by Mr. Robichaud, seconded by Mr. Dumas, be referred to the Steering Committee:

That a report be presented to this Committee on the investigation carried out by the Saint-John River Board.

That the four members of the said Board be invited to appear before this Committee prepared to discuss:

(*a*) Federal expenditures in connection with investigations carried out by the Board;

(*b*) Share of expenditures by the government of New Brunswick or other agencies;

(*c*) Water Storage facilities available from the Saint-John River Basin;

(*d*) Any other matters pertaining to the flow of the Saint-John River and its tributaries as it relates to present and future power developments along the said river.

At 12.45 p.m., the Committee adjourned to the call of the Chair.

M. Slack,
*Clerk of the Committee.*

# EVIDENCE

MONDAY, April 11, 1960.
11:00 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. I call the meeting to order.

At the request of Mr. Mitchell, the steering committee agreed to ask certain witnesses to appear before this committee to discuss the Harricanaw river diversion proposal.

In order to put the request on a formal basis, would someone care to make a motion?

Mr. MITCHELL: I move that the expenses usually accorded in these cases be extended to Mr. Kierans, Dr. Hare and Mr. Evans.

The CHAIRMAN: Is there a seconder to that motion?

Mr. GODIN: I second the motion.

The CHAIRMAN: You have heard the motion. It has been moved and seconded that the committee should call these witnesses and that the usual remuneration by way of expenses be permitted to them. Those in favour? Contrary, if any? I declare the motion carried.

Motion agreed to.

I do not know in what order you wish to have these witnesses appear. Perhaps Mr. Kierans, Dr. Hare and Mr. Evans have made an arrangement amongst themselves. I shall give you a brief background, a biographical background, of the witness.

Mr. Kierans was born in 1913, at Montreal, Quebec. He graduated from McGill university with the degree of mining engineering. He has spent approximately six summers as a prospector in northern Quebec, British Columbia, and northern Ontario.

After graduation he joined the International Nickel Company and worked with them from 1939 to 1957 as mining engineer, safety engineer, and senior mine supervisor for 18 years.

Since that time he has been chairman of the board of directors of the Rockiron Company Limited and president of Load Lines Ltd., and the Rockiron Contracting Company Limited.

He is a member of the Canadian institute of mining and metallurgy, and he is district representative for the Sudbury branch of the Canadian Institute of mining metallurgy.

We have with us also Dr. F. Kenneth Hare, professor of geography at McGill university. He is a governor of the Arctic institute of North America and a director of the Arctic meteorological research group.

He has held these posts at McGill since 1952, having held more junior jobs for the same institution before that. During this time he has become increasingly occupied in northern research of various kinds, particularly in Labrador-Ungava.

He has been able to build up at McGill what is probably the largest graduate school on northern geography. In addition, since 1949, he has been engaged in protracted survey of the Labrador peninsula for the Department

of National Defence, and the results of this survey have just been published by the Department of Mines and Technical Surveys.

We have with us also Mr. Robert Evans, a columnist with the Sudbury *Daily Star,* and also a commentator for radio station CHNO. He has been news editor of radio station CKSO and also for CKSO TV in Sudbury.

Prior to that time he lived in a resort town in Maine, and he says he lived the retired life of a gentleman until his money ran out.

Gentlemen, that gives you a pretty fair biographical sketch of the three gentlemen present, and we shall proceed to discuss the Harricanaw river diversion proposal.

Which of you gentlemen would like to speak to us first? Mr. Kierans?

We have some copies of Mr. Kierans' submission here, which we will distribute to you.

Mr. THOMAS W. KIERANS (*Engineer, Rockiron Mines, Sudbury, Ontario*): Mr. Chairman, and members of this parliamentary committee: first of all, I want to express to you my deep gratification to all those who have participated in any way in affording me this splendid forum in which to outline for your consideration this admittedly imaginative, bold and needless to say, gigantic scheme which, it is our thought, may solve one of the most pressing problems which faces not only Canada but, in our opinion, the whole of North America as well.

First of all, when one considers a project which has a value of approximately —$2 billion—one is inclined to let ones thoughts range rather far and wide.

However, just before I left my home town of Sudbury to come down here to speak to you about this tremendous water project, I was rather suddenly taken aback by my good wife, when she said: "Now you are going down to Ottawa to talk about your big water problem, I would still like to remind you that you have not yet fixed the bathroom tap."

So I think it is very important that we are brought back to earth from time to time. However, I think you will agree, as we progress in the description of this project, that while we may not have the solution, we do have a problem.

I would like, first of all, if I may, before this committee, to thank those many persons who from time to time have discussed with me the various aspects of this problem.

These include many with whom I have communicated by word and by letter, foremost among whom is the Hon. Alvin Hamilton, who very kindly, replied to my very brief letter to him. Rather than take the time to read it over, I would be quite prepared, to submit a copy of my original letter to the minister and also a copy of his reply to me.

The CHAIRMAN: Just a minute. Gentlemen, would you like to have these letters included in the report?

Mr. DUMAS: Yes, included in the report.

The CHAIRMAN: Very well; they will be included, as read.

c/o The Rockiron Company Ltd.,
67 Sudbury Junction Road,
Sudbury, Ontario,
January 25, 1960.
The Honourable Alvin Hamilton,
Minister of Northern Affairs & Natural Resources,
Ottawa, Ontario.

Dear Mr. Minister:

*Re: James Bay Water Reclamation Project*

Recently I discussed with Dr. Kenneth Hare, Head of the Department of Geography at McGill University, the possibility of investigatiing

the reclamation of the northern waters flowing into James Bay, by effecting a practical separation of fresh from saline waters in the bay, and then re-introducing them into the Great Lakes and St. Lawrence river water systems on a large scale, by pumping them up the Harricanaw river to the height of land, and then into the Ottawa river. The route would then be via the Mattawa river, Lake Nipissing, and the French river to the Great Lakes, or as an alternative route, down the Ottawa river to Montreal, to aid in improving the port conditions in Montreal. It is contemplated that this plan would also provide an incentive to the opening up of the area covered by establishing a barge navigation system. It was proposed that the northern waters so reclaimed could be sold under joint international control, and at a profit to Canada, to those areas interested in obtaining increased water supplies in the Great Lakes and St. Lawrence watersheds. As a source of power for the reversing of the Harricanaw river, it was proposed that hydro-electric power plants would be established on the Eastmain, the Rupert, and the Bell rivers, which would provide pumping power during the off-peak periods, as such power plants would be designed to feed power into the national network as required. The pumping stations on the Harricanaw would be of the pumping generator type such as those now in use at Niagara Falls, where large scale pumping is carried out in the off-peak period. An alternative source of power would be an atomic power plant located on the Harricanaw itself, and possibly at Mattawa also.

Thus, the four benefits which might be anticipated if this plan of reclamation could be established as feasible, would be as follows:

(1) The sale at a profit to Canada of waters now being wasted in their flow to the Arctic. As you know, the water supply problem in the Great Lakes area, and in the United States in particular, is rapidly becoming critical, and the U.S. government has brought this to our attention on numerous occasions. I refer in particular to the Yearbook of Agriculture on Water, published by the U.S. Department of Agriculture in 1955.

(2) The opening up of a large area of Canada by means of an inland barge navigation system, which could be used to transport the iron ore and other resource products of James bay.

(3) The possible assistance to Montreal in improving port conditions, by providing a greater source of water, which would at all times be under full control.

(4) The improvement in our supply of hydro-electric power for industrial purposes in Canada.

I am very pleased to say that Dr. Hare was quite impressed with all the possibilities which this plan offered for the development of our natural resources, and seemed quite satisfied that a feasible plan for the complete separation of usable fresh waters from the moderately saline waters of James bay could be worked out on a practical basis. Dr. Hare referred me to you, as Minister of the Department of Northern Affairs and Natural Resources, as a possible source for funds for further study and investigation of the plan. I am enclosing herewith some clippings which you will agree rather glamourize the project at such an early date; however, I think it does reflect the great interest of the public in such a vast, and it is hoped profitable project for Canada.

I respectfully draw your attention to pages 112 and 117 of the Yearbook of Agriculture on Water, published by the U.S. Department

of Agriculture in 1955, dealing with the conversion of saline waters, in which the congress of the United States in July 1952 authorized the federal government of the United States to participate in research and development in this field for five years. It provided that the Department of the Interior find practical means for the economical production, from sea or other saline waters, of water suitable for agricultural, industrial, municipal and other beneficial consumptive uses.
(66 Stat. 328, 482 U.S.C. Sec. 1951)

Further in this, in 1955 amendments were enacted to The Saline Waters Act of 1952, extending activities to 1966, and increasing the total authority from $2 million to $10 million.

Would you be good enough to consider and advise us on the question of applying to the Department of the Interior of the United States in regard to the possible use of some of the funds made available under the Saline Waters Act mentioned above, for the purpose of conducting feasibility investigation into our James bay waters reclamation project. It would appear to me personally at this time that it would be more to the ultimate benefit of the Canadian people, if the funds provided for the feasibility investigation into this project could be provided by the Canadian government. Naturally we are quite aware that the eventual development of such a plan would be extremely costly, but when we consider the vast benefits possible both to our country and to the United States, I feel confident that you will agree that the full investigation of the project is warranted.

I would be very pleased to go to Ottawa at your convenience to discuss with you fully our proposal.

Respectfully yours,
T. W. Kierans.

Mr. KIERANS: I think it would be proper, if I may, Mr. Chairman, to read the reply of Mr. Hamilton to myself, one which I indeed appreciated very much. It might well clarify some other remarks which from time to time might have been made about this project, and indeed, his attitude towards it.

I have since written a very brief note to Mr. Hamilton, which I attached to one of the briefs you have before you. I thanked him in this letter, and indeed made note of the fact that we have taken advantage of some of the suggestions and criticisms made in his letter. The reply from Mr. Hamilton reads as follows:

Ottawa, February 16, 1960.

T. W. Kierans, Esq.,
c/o The Rockiron Company Ltd.,
67 Sudbury Junction Road,
Sudbury, Ontario.

Dear Mr. Kierans:

Officers of my department now have made a very preliminary examination of your proposal for transfer of James bay water to the Great Lakes via the Harricanaw, Ottawa and French rivers as outlined briefly in your letter of January 25.

It may be that your proposal will have possibilities in the distant future but at the present time it appears that the cost of treatment and transfer of James bay water to the Great Lakes would be prohibitive. Even if the need for treatment were obviated by the construction of

barrier dams in James bay to create fresh water areas into which the various rivers would drain, it is likely that these dams would be very costly also. It is obvious that more than 3 million hp. would be required to lift 25,000 cubic feet of water per second from James bay to the headwaters of the Ottawa river and it is unlikely that off-peak power sources of this magnitude would be available in the foreseeable future.

The Harricanaw river lies almost entirely within the province of Quebec. It is questionable that that province would be interested in your proposed use for this river when the principal advantages of your scheme might accrue to Ontario or to the United States.

At the present time the area contiguous to the Great Lakes is not suffering from an acute shortage of water, but there is a lack of transport facilities from the lakes to some parts of the area. It is doubtful if a diversion of water through Chicago would serve to meet the needs of the United States areas where the water shortage is most acute.

The benefits to navigation would be limited severely by the very short open season on James bay (roughly five months) and the even shorter season in Hudson strait (three to four months).

Any water sold to the United States presumably would leave the Great Lakes system at Chicago and only the remainder would be available for use on lakes Erie and Ontario and on the Niagara and St. Lawrence rivers. The addition of 25,000 cubic feet per second would raise the present inflow into Lake Ontario only by perhaps 12 per cent. It is doubtful if this increase in inflow would improve pollution conditions at Toronto to any great extent. It is evident that dilution is no longer a completely effective method for pollution control for metropolitan communities.

I understand that the United States program for research into the conversion of saline waters is directed primarily to the development of a feasible method for the purification of salt water at reasonable cost to meet water shortages which are occurring in the coastal areas such as southwestern California and southern Texas. I do not believe that the United States would provide funds for investigating a scheme outside the limits of the United States.

Nevertheless, as the problems and solutions you have outlined, so far as Canada is concerned, would seem to benefit largely Ontario, they should be examined by that province. Possibly the Ontario Water Resources Commission would wish to consider the implications of your proposal.

I am sure you will appreciate here that Mr. Hamilton's remarks have been constructive. They certainly did not hand us a huge sum of money at this time with which to carry on this project; nor was that particularly asked for at this time. We were very much interested in obtaining the views of various important people on the various aspects of this situation—and this I believe we received.

Furthermore, there were two constructive parts to this communication of Mr. Hamilton's: one, of course, was his remarks in regard to salt water. At that time we were considering this matter, and we were attempting to obtain information as to the salinity of the waters contiguous to the southern end of James Bay. We have had considerable trouble in obtaining the most up-to-date information. As a matter of fact, I received this most up-to-date information only a very short time ago. These are the results of a survey which I understand was completed only last year, so it is quite understandable.

However, as a result of this criticism by Mr. Hamilton we did direct our thinking towards completely eliminating this problem in our project of converting salt water. We dropped this end of the investigation and directed our attention more towards the problem of recovering not only completely fresh water, but a very good grade of fresh water.

This was one of the constructive features of Mr. Hamilton's remarks. Another was his reference that we should refer the matter to the Ontario water resources commission. In due course we did take the problem to Dr. Berry. I certainly would not like to comment on Dr. Berry's attitude at the moment towards this project, because I understand that he and Mr. McCauley have initiated a study; but in any case it was as a result of Dr. Berry's enthusiasm, and also enthusiasm shown to me in regard to this project by Mr. Charles MacNaughton, member of the Ontario legislature, that this proposal was prepared in its present form. And this proposal you have in front of you at the moment.

Mr. AIKEN: Mr. Chairman, I wonder, before Mr. Kierans goes any further—some of us are very interested in the project—whether he intends to proceed now with reading the proposal.

Mr. KIERANS: That is correct.

Mr. AIKEN: So that we will get it into our minds.

Mr. KIERANS: That is right; I am now going to try to put this project into as brief a form as possible.

Gentlemen, if we look at this map of the central part of North America—and I am very deeply grateful to Mr. McLeod for his very kind preparation of this matter—we see a very natural problem. We see here in the great lakes area a huge area of water. This represents a tremendous quantity of water, a tremendous surface of water; but there are a considerable number of essential features about this water that we must take into consideration, apart from its immense size.

The first feature is, that in order to serve those communities which lie on its shore, it must be maintained at a constant elevation. In other words, in so far as the use beyond a set depth, or set elevation of the water, we might consider the whole area as being a sheet of glass because, while there are tremendous quantities of water in the lakes themselves, these levels cannot be altered without closely affecting the culture of the communities on their shores.

Another very important feature is that the communities on this natural discharge of the St. Lawrence river depend for their economy on the maintenance and the elevation of the discharge as well as on the continuance of the natural flow of this river. I would say, by nature, that the people on this discharge area are entitled to the maintenance of this flow.

However, we will note that the height of land south of this great lakes area is very close to the lakes. In other words, those communities lying on the southern shore are hampered in so far as water problems are concerned—and this covers many of the problems of water. Problems of water are not entirely a shortage of water. Scarcity is only one; variability is another; and then there is the control of water supplies, pollution, dilution, and all the other problems to which we have to give consideration. In other words, it is not only a case of a quantity of water. Actually, it is, first of all, the use and the control of this water. Now, lying as it does, a very heavily populated area on the southern shore of these lakes has access to only the head waters of the huge rivers flowing south. It has no huge rivers flowing north—it cannot have—so their culture must be based on the use, and the continued use, of the waters of the great lakes themselves.

I would like to point out that according to economic geographers the density of population in this area on the map is of the order of 250 persons per square mile, while the density of the population in this area on the map is of the order of 2 persons per square mile. So, we have then, here, a huge basin or area of water—and to give you some idea of its volume the flow at Niagara falls is roughly 200,000 cubic feet per second, and that out of Lake Ontario is of the order of 235,000 cubic feet per second. In order to give you some idea of what these figures mean, I phoned the hydro people here at Ottawa this morning, and learned that the present flow of the Ottawa river this morning past our doorstep here is 69,000 cubic feet per second. This will give you some idea of the problems we are facing. However, I can tell you that, normally, the levels of the Ottawa river are maintained in summer months at about 35,000 cubic feet per second, occasionally going down to as low as 25,000 cubic feet per second. When they get over 80,000 cubic feet per second we are in danger of flooding.

I have digressed here, in order to give you some idea, from an immediate picture, of the quantities of water with which we are dealing. So, we have a natural problem in this area here. I will go into various aspects of this problem. It affects not only the northern part of the United States but also southern Ontario. As you know, we have heard of consideration being given to the diversion of some of the waters of Lake St. Clair across the channel. Certainly, we know of the request of Chicago for diversion through their sanitary canal, and have had comments in regard to other diversions in the lake area, as well as in the Lake Ontario section.

We have a tremendously growing population. The census of the United States for this year will be of the order of 200 million; in 1980 it is estimated it will be of the order of 265 million, and by the year 2000, of the order of 300 million odd. Therefore, we have a problem, which is pressing at the moment, and which gives every indication of becoming even more pressing. This is a natural problem. Speaking as an engineer, a natural problem should have a natural answer. We think that Canada has been blessed with such an answer.

If you look at the northern portion of the map you will notice that we have in this area a tremendous flow of rivers which—and please bear this particular point in mind—focus on James bay. In other words, the waters coming from many hundreds of miles apart come to a focal point at James bay, particularly at its southern end. This natural feature gives us a clue to one possible answer to our problem. First of all, we have a natural collection of not only fresh water but of a very good grade of fresh water. It is not a hard water. I can refer you to the remarks of the water resources commission, in which they referred to the waters of the Canadian shield as being excellent so far as hardness is concerned.

Another natural feature that we have to take into consideration is the natural advantage of a collecting point for hydro-electric energy. In other words, while we have this tremendous area of water-bearing soil, with a run-off focusing on a comparatively small part of the basin, we also have a focal point for the collection of hydro-electric energy. In order to solve the natural problem of the southern area, with which we are faced at the moment, and which, as I say, is becoming increasingly urgent, these two features are essential: first of all, a collecting point for fresh water and, secondly, hydro-electric energy needed to transport this fresh water.

We have been blessed also with another natural feature—and this you will notice, if you look at your topographic map, which we have included in our brief. I believe it is on one of the inside pages.

The CHAIRMAN: What page?

Mr. MARTEL: Page 5.

Mr. KIERANS: It is on page 5.

On some of your desks I have placed the topographical map of the Department of Mines and Technical Surveys, showing an outline of this particular topographical feature. I want to draw your attention to the outline in greater detail; and this feature to which I want to draw your attention is a slot in the topography of the area which somehow—providentially it seems to me—runs from the bottom of James bay to Georgian bay. Also, again providentially I think, we are faced with the fact that another natural topographical feature lends itself to the solution of our problem of transportation, but more particularly control. In other words, if we have now a natural problem of a shortage of water—looking upon this problem in its simplest terms—we have also a natural collecting point for such water.

As I mentioned earlier, while the salinity of James Bay is quite low—of the order of ten parts per thousand, as compared to 35 parts per thousand in the ocean—nevertheless, we do not wish to introduce into our scheme, in any way, shape or form, anything but fresh water. However, we do have a natural feature here which does help us in this problem, and that is a lowland area similar to the lowlands of Holland. This feature gives us an opportunity to collect water by canal.

While this feature is certainly of some advantage it can also be a disadvantage because waters flowing through such areas are inclined to take up silt. So we have purposely included in our reasons for selecting the Harricanaw the fact it has a comparatively shallow depth of lowland area. Another reason we have selected the transportation media of the Harricanaw valley is because it is closest to our as yet great unharnessed sources of electricity.

I think, then, if we take this picture in its broadest sense and we consider the tremendous problem in the area—and I do not wish to emphasize water deficiency as being the sole problem of this area; water variability is also a tremendous problem. We see this in the press right now, the attempts of those people living in the northern part of the United States to conserve their available water supplies, and their conservation measures. While I am certainly in no position to state why they are having floods down there, I feel if we were having floods in Canada we would certainly look not only to the problem of conservation but also to that of control. In other words, if water is held back in order to satisfy the low periods of summer months and then a flash flood occurs, this water must be released. There must be some area in which water can be conserved in order that these tremendous quantities of water collecting in the winter months can be allowed to run off normally and be absorbed in the flash floods in the spring.

One of the purposes for which we have mentioned in our brief the revision of our concept of the Great Lakes as being a source of only prime water—or areas lying on the Great Lakes drainage basin and its natural discharge—is that we feel in solving some of the problems of North America we could make the Great Lakes our huge reservoir area, without in any way changing the natural rights, and, indeed, improving on the natural rights of those people living on its natural discharge. We would also do something to help solve the problems of those areas lying to the south; that is here.

To summarize: we have a natural problem here, not simply of deficiency but also of control, and that control can be provided only by means of a reservoir; a natural and very large area for collecting good quality fresh water, lying to the north; a natural collection point for energy with which to transport this water; a natural channel through which such water can flow; and a natural control point here, at the junction of the Ottawa and Mattawa where,

lying completely in Canadian territory, we can control the flow not only of the Ottawa river but also the flow into the Great Lakes drainage basin.

To boil this down into its simplest terms, we find ourselves simply with a plumbing problem, just the same as you would have in your house. In other words, do you want the water bad enough to pay for it?—because it costs money to carry out such a scheme.

If we can conceive a problem of this magnitude, and if we can conceive a solution to a problem of this magnitude, there will be a time when, I am sure, this problem will have to be solved. There are other solutions to this problem and we find, in some way, we have made an effort to help solve it. As you know, a diversion has been made on the Ogoki here. It has added some 5,000 cubic feet a second to the flow into the Great Lakes, and we get some credit for this, but not in every way.

The use of water is not confined alone to hydro-electric purposes, but it can be used and re-used industrially, and used as a means of maintaining navigation. While we have certainly obtained credit at Niagara Falls and on the various power plants down through the international section of the St. Lawrence river of 5,000 cubic feet a second, which has been added to the Great Lakes basin as a result of this diversion, we have not obtained full value for this diversion, nor can we ask full value. I cannot quite see how we can ask full value.

Furthermore, to my mind there is one serious detriment to this type of approach. Canada, in this northern area particularly, is looking forward to a great period of expansion. All down through these areas we are finding new mineral developments, new forestry developments. We do not know them all, and we cannot conceive some of the developments that are going to take place on north-flowing rivers.

In order to solve this problem which I speak of, if we continue in a piece-meal way and make headwater diversions of our north-flowing rivers, we are going to penalize the future development of this country by virtue of the water we divert.

There is one other serious disadvantage in this, in that it becomes quite inflexible once such a diversion is established. It is a very difficult thing to change. The only thing you can do is to move the dam, and this creates considerable problems.

The only other solution I can conceive as being a practical one is to permit the waters to flow to their natural collecting point, and then to use the energy which is also collected at this focal point to return them to the point where the problem exists by a single channel—perhaps, in time, another but completely controllable channel, one which does not penalize the future of Canada by any such diversions as were made.

The CHAIRMAN: I am sure there are a lot of questions on the mind of the committee, and, as you know, our time is limited. I wonder if it would now be an opportune time for you to allow the members of the committee to ask some questions?

Mr. KIERANS: I would be glad to.

Mr. EVANS: Might I make a suggestion to Mr. Kierans? There is one important point he has not brought out specifically, regarding this diversion.

Mr. KIERANS: I would like to mention one more point, and then I would be quite happy to follow your suggestion, Mr. Chairman.

There is one point I would like to emphasize here. If we assume these problems exist—and we have some arguments, I believe, to prove these problems do exist—equally, we have some arguments to show these solutions exist. This is not a small solution. What we are looking at in this problem and this potential solution is possibly the greatest single engineering project in the

history of the world. We have given you a figure of $1,800 million. I do not know what the final figure is. I do know, however, that the department of the interior have estimated that the United States is going to spend within the next fifty years between $75 and $100 billion on their water projects. Dr. Hare will also speak of a similar project in California and there is another similar project in southern Australia.

I think there are certainly tremendous problems connected with this thing and I would be the first to insist that we do not minimize these problems; but, I think we should consider the possible solution.

Mr. McGREGOR: Perhaps you would explain the purpose of this. It may have been brought up before, but if so I have not heard it explained. Has the purpose of this been explained?

The CHAIRMAN: Not before this committee. There was a request by some of the members to have it discussed. Perhaps Mr. Kierans might answer that question for you.

Mr. KIERANS: What we have tried to show here is that we have a water problem in the northern part of the Great Lakes area, in the northern part of the United States contiguous to the Great Lakes, and in the southern part of Ontario where we have a water problem. This problem can be solved only by adding new water. If diversions are to be made such as are wished to be made in the southern part of Ontario, in the Chicago, Lake Erie and Lake Ontario area where there is a tremendous concentration of people living, and if we at the same time wish to maintain the levels of this huge area, there is only one solution and that is the introduction of new water.

Mr. McGREGOR: How do you propose to get the water down.

Mr. KIERANS: We would pump it down, using the power on the Eastmain, Rupert and Nottaway rivers and pump it up the Harricanaw river the 960 feet, let it flow down the height of land into the Ottawa river, down the Ottawa river into the Mattawa river and lake Nipissing and down the French river. Does that answer your question?

Mr. McGREGOR: I suppose so.

Mr. AIKEN: Do I understand that rather than pick up the water from James bay you would join together a number of the rivers along the edge of James bay and take the water from there before it enters the bay.

Mr. KIERANS: Yes. We would attempt to collect the water here in this focal area, and then take it back up the Harricanaw.

Mr. AIKEN: How many of those river basins would you anticipate joining together?

Mr. KIERANS: Unfortunately, the information we have as to the quantity of water flowing down those rivers is not entirely complete. I understand the Quebec government are making a survey of these waters at the present time, both as to their flow and their hydro-electric energy. To the best of our information the discharge at the Harricanaw is of the order of 14 to 18,000 cubic feet per second. At Amos it is 2,000 cubic feet per second. Does that give you some idea of the amounts of water involved?

Mr. AIKEN: They would have to be connected by channels or canals.

Mr. KIERANS: Yes.

Mr. AIKEN: Certainly in the James bay area.

Mr. KIERANS: At the bottom end of the James bay area.

Mr. ROBICHAUD: What is the distance of Georgian bay from James bay?

Mr. KIERANS: The airline distance from James bay to Georgian bay is 360 miles. The water route distance which we propose is 560 miles. The percentage of this distance which travels through open water at the present time amounts to about 43 per cent of the 560 miles.

Mr. DUMAS: Mr. Kierans, has this project been submitted to the province of Quebec?

Mr. KIERANS: I am afraid the only thing I can say is this. I appreciate this question very much and am quite embarrassed at the answer I have to make. At the present time we have had to occupy our minds, unfortunately, with our normal business affairs. This is a private project at this time. At the present time we are trying to advance this project ourselves and draw it to the attention of the governments concerned. Mr. Johnson of the Quebec water resources commission was given a copy of this about two weeks ago. I would have much preferred to have taken this down to him myself. My brother, Mr. Kevin Kierans brought it to his office. I do not think he was able to see Mr. Johnson personally, but he did leave it in his office.

Mr. DUMAS: The fact is that about 80 per cent of the work is in the province of Quebec. I would think it should be brought to the attention of the province, because it is more than a private enterprise; it is a large enterprise.

Mr. KIERANS: I must agree with you on this.

Mr. DUMAS: Many rights have to be considered. For instance, there is the diversion of the Harricanaw waters to the south, the tremendous construction which has to be undertaken, and then the power situation.

Mr. KIERANS: That is right.

Mr. DUMAS: I understand that already on the Nottaway river the total hydro development there is estimated at two million horsepower and Mr. Chagnon has stated only a few days ago that part of this will be developed within the next few years. No doubt this will be for the development of the natural resources of Quebec. He mentioned that most of this power on the Nottaway is already committed. This would probably give you difficulty in respect of some of the power for your project. Then there is the Great Whale river on which the power is estimated at one million horsepower, and this power is committed also to the iron smelter there. For these reasons, I think this large project should be brought first to the attention of the province of Quebec.

Mr. KIERANS: The only thing I can say to the members of the province of Quebec is to express my apology for not having spent more time on this aspect. I hope you will accept this apology from a private business public man, at this particular time, living in the province of Ontario. I was occupied in my own personal business affairs and was able only to send this message down to Mr. Johnson. It was impossible to give this matter all the attention that Quebec should expect, with all the interest they have in this project.

I would like to point out that while this certainly does affect the power situation in the province of Quebec, there is a tremendous revenue from the sale of this water, there is a tremendous revenue in respect of the development of the area contiguous to it, and there are many advantages which the province of Quebec would certainly realize. There would be an assured sale for a great amount of power and an assured sale for a resource which at the present time flowing northward has a comparatively small value. This water delivered to Chicago could be sold at a very high value and probably in many ways, so far as value is concerned, would be in excess of any of the other natural resources which could be developed in this area.

My brother and myself have discussed this problem and have often wondered when we could get down to Quebec to explain this problem to them. We hoped there would be some members here from the province of Quebec. I am very glad to see there are, particularly the member from Amos. I spent my early days in mining at Amos, and as a matter of fact I earned my first dollar there. I am very much aware of the tremendous concern the province of Quebec would have with regard to this project. As a matter of fact it undoubtedly has the major concern. However, since this is an inter-provincial matter and certainly concerns the federal government, and since it concerns the huge area lying to the south of us, we felt we could only do what it was possible to do and still continue our normal business affairs.

Again I wish to apologize to the province of Quebec for not having spent more time with them on this matter, and I hope you will accept my apology.

As an additional advantage, just imagine the dredging of the Harricanaw river. I think it would also ensure a road from Amos to James bay, although it is not included in this project. This tremendous engineering structure would call for such a road and the materials for the building of the road would be actually taken from the river bed. Amos would have a motor road from James bay. We have not included this in our estimate of the advantages.

Mr. McGregor: What kind of material is in the bottom of the river?

Mr. Kierans: One of the reasons we are rather pleased with this area, here, is that it runs through the clay belt. This gives a certain disadvantage, but also some advantages. The channel to carry this amount of water would be quite large. It would be of the order of 250 feet wide by 20 feet deep. You would have to have material to go through which would be comparatively cheap to dredge, and the clay belt of this area here we feel would give this advantage.

It has a certain disadvantage in the maintenance of the sides of the channel are more costly than would be the maintenance of the sides of the channel down through the French river area, where the sides would be in rock. But the cost of excavation in rock would be greater. However, in any case, of necessity we would have to open up a channel much greater than exists at the present time.

Mr. Dumas: You are saying that this would provide a road to James bay. If I am correct, maybe you are aware that there will be a railroad built within the next two years to Red Dog, south of Mattagami.

Mr. Kierans: Yes.

Mr. Dumas: There is a project for a railroad also right to James bay within the next few years.

Mr. Kierans: If you consider a channel of this size going through the province of Quebec, we do have a tremendous opportunity to take some of the raw material from there to markets in one single stage on the Great Lakes. This may sound visionary, but this has been done on the Missouri. In the years since they started their conservation program on the Missouri they have increased their barge traffic from 50,000 to 500,000 tons a year.

If you are developing raw material here in this Red Dog area, these raw materials would have a much greater sale if they could be loaded in one stage and taken to markets to the south, in the states.

Mr. Martel: This project you mention is mostly located in my riding. And, as I see it, reversing the Harricanaw river which flows into James bay, would present a project of very real magnitude. But I am afraid that with the immensity of this undertaking it would not be possible right now.

However I am prepared to agree. I do not know the technical aspects of this problem, because I am not an engineer myself or anything like that; but I am prepared to agree that it would develop this country very much.

You have mentioned a shortage of water south of the border, or in the northern states. Who would pay for the use of this huge volume of water which would have to be pumped upstream?

We had an expert from the United States Department of Agriculture appear before us recently, and I asked him whether his government or the government of the state of Illinois, would be willing to buy this water.

I wonder if there has been any agreement, or if you have contacted these people? If you are aware that they are interested, then how much would they be willing to pay for it?

Mr. KIERANS: We have estimated that to pay for the cost of this water we would have to charge 1½ cents per thousand gallons.

The value of the water depends on where it is. For instance, the taps in this building, or in this room deliver water, but you have to pay for that water something between 16 and 21 cents per thousand gallons.

Mr. MARTEL: Yes.

Mr. KIERANS: But up the Gatineau, on the upper Gatineau, the Gatineau Power Company pays one-tenth of a cent per thousand gallons. That is, up above their power plants.

For irrigation water in the United States they pay roughly ten cents per thousand gallons, and as high as 30 cents per thousand gallons.

Mr. MARTEL: Did you say one-tenth of a cent up the Gatineau?

Mr. KIERANS: That is right, above their power plant.

Mr. MARTEL: By the owner?

Mr. KIERANS: Yes. The value of these waters is going to be greater to Canada than the value of the iron ore at Belcher island right now.

That iron ore probably right now to the eskimos has value only as something with which to colour their artifacts; but when it is delivered down here, it is worth $12 a ton.

The value of the water is one and one half cent per thousand gallons. But the people down here are asking permission to take a thousand cubic feet per second more. They would like to take 5,000 cubic feet per second, I understand.

I asked Dr. Berry, the chairman of the Ontario Water Resources Commission, what we should expect for our water from Georgian bay, and he said that we should not have any trouble in getting one cent per thousand gallons, and that if we got 1½ cents we could pay for this project and eventually make some profit.

Mr. MARTEL: You are referring to water which would be sold to the states.

Mr. KIERANS: Yes.

Mr. MARTEL: That would involve obtaining governmental permission.

Mr. KIERANS: That is quite true. But in order to solve this problem we have to make certain estimates with which to carry through our thinking. In so far as I am concerned, the waters in the Great Lakes are at the present time international.

Chicago has made such remarks—or some people in Chicago have made such remarks as these: that they would take 100,000 cubic feet per second, whether we liked it or not.

Mr. DUMAS: How many cubic feet did you say?

Mr. KIERANS: Oh, I am sorry, I should have said 1,000 cubic feet per second.

But over here, let us suppose that at some future date developments on the Ottawa would require the use of a greater amount of water, and that they wished to take from Georgian bay another 1,000 or even 3,000. What would happen eventually to our Great Lakes area? If they dried up, they would become simply an area of travel. So I think we must accept the fact that sooner or later the present situation of international control of levels on the Great Lakes will be incidental to the actual diversion which will be permitted from the Great Lakes.

I accept as a possible part of this solution that there will be an international Great Lakes reservoir commission which will be set up to control the diversion which will be made, not only perhaps in the southern part of the Great Lakes, but also diversions which might be made in Canada itself.

Then there is another aspect to this problem which I must emphasize. It is that these (pointing) waters are sovereign waters of Canada. They belong to us, and they should not be diverted at such places as the Ogoki, where we cannot be paid for them. They should only be diverted at places where we can get paid for them.

So if we accept an international commission, to be called the Great Lakes reservoir commission, we should have another commission, which would be a national commission to control completely the sovereign Canadian James bay waters reclamation, to benefit those people from whom these great resources had been taken.

Of course I am sure you realize that these great resources originate mostly in the province of Quebec. So the advantages certainly would have to benefit this area where they originated.

The CHAIRMAN: Mr. Kierans, unless somebody has a specific question, since our time is going on, I am sure the committee would like to hear from Dr. Hare, if it is possible.

Mr. SIMPSON: I have just one question. I probably missed the point, but in order to reclaim these waters from James bay, is it your plan to take the flow of these various rivers after they enter the bay and to pump them back in?

Mr. KIERANS: No; it is to channel them together before they get to James bay in order to ensure that you only get a high quality of water.

Mr. SIMPSON: Approximately how many of these main rivers do you contemplate tapping?

Mr. KIERANS: It looks as though, in the initial phase, we can take 4,000 cubic feet a second, which is all the Great Lakes are asking for at the present time. We assume that this will increase quite rapidly as it becomes realized that water can be of advantage to this area. But we assume that at the start it will be 4,000 to 5,000 cubic feet per second. Eventually, as it reaches our proposed figure of 25,000 cubic feet per second, I am quite sure we would have to take in part of the Nottoway.

An Hon. MEMBER: What is the average flow of the Harricanaw river?

Mr. KIERANS: The only place where we have a government station is at Amos, which is 20 miles from its source. At that point it is about 2,000 cubic feet per second.

Mr. SIMPSON: We could use the Ottawa river, then, orginally as a watershed for the Harricanaw?

Mr. KIERANS: I would say that you would not even have to take it up to full height, and could still maintain adequate supplies at Amos—in fact,

improve upon them—and obtain the desirable feature of putting the great central part of Ontario and Quebec on the same waterways as the Mississippi, with all the advantages.

Mr. KORCHINSKI: Does your plan envisage the construction of canals and dams so as to raise the water at a certain point in steps, or do you plan a series of pipes; that is, pipelines or something similar, which will carry the waters from one point to another?

Mr. KIERANS: I would like to answer that categorically. I would not like to say that we are going to do this, or we are going to do that. Naturally, it could be either one or the other, as a result of the engineers' studies which should be conducted. At the present time I am inclined to think there would be five to ten-mile long channels with 90 feet lifts, going up 960 feet as we eventually get down to the bottom of the bay.

In other words, in order to get to the collecting point for 4000 cubic feet per second it is difficult to say how far down you would go at this time.

Mr. KORCHINSKI: At the present rate of growth around the Great Lakes and the St. Lawrence basin, when would you say the acute point, as far as the requirements of water is concerned would be reached?

Mr. KIERANS: I would say that right at present time we should have 5,000 cubic feet per second added to the Great Lakes.

Mr. KORCHINSKI: In other words, there is a water problem at the moment?

Mr. KIERANS: Yes, I do not think there is any question on that point. We have the demands of the Chicago area right now for at least a test of 1,000 cubic feet a second, and it is expected this is only a means of getting a foot in the door so that they can take more. But we in Canada are naturally opposed to this; and particularly those other states on the Great Lakes who are also very much concerned with Chicago taking this water.

As a matter of fact, they have much more control over it than we do, because it is not an international water.

Mr. MCGREGOR: Has Chicago agreed to pay any particular price?

Mr. KIERANS: We have not approached them on that. But we could go to them, as a customer, and say: "If you wish to take this water, then the price is so-and-so." The price, in order to deliver this water to them, is not excessive.

I can give you some figures. I should really go along with your suggestion, Mr. McQuillan, and have Dr. Hare speak on this point. But there is a tremendous project which is something similar in southern California, called the Central Valley project. It covers an area of 500 miles in length, by 180 miles in width, in which water was transported in a similar way to the method we are speaking about here, and with about the same quantities involved. The cost was $500 million to $600 million. We know the terrific advantages to be obtained from it; we know the financial returns to be obtained from the project, and I can give you those figures.

The CHAIRMAN: We did hear a bit about that from Mr. Fox, the previous witness, who briefly covered the project down there. I think the committee is reasonably well aware of that particular project.

Mr. KIERANS: Fine.

The CHAIRMAN: But I am sure the committee would like to hear Dr. Hare. I would like to give you all the time possible, but we do have other witnesses to hear.

Mr. KIERANS: I appreciate that very much, Mr. McQuillan.

Mr. MARTEL: Mr. Chairman, I have a question that requires just a short answer. Mr. Kierans mentioned that it would be possible to make a road along the Harricanaw to the James bay area. I suppose you are aware of the topography along the Harricanaw. As you know, it is very low in certain places.

Mr. KIERANS: That is right.

Mr. MARTEL: Do you know, also, that there is a kind of height of land between the Harricanaw and the Nottaway? It is mostly in the form of a sand ridge and goes quite a distance south. It starts near Val-d'Or and goes north. I am told they are building a road along it to serve a mining district. I suppose it would be easier to build a road along the sand ridge than it would be to go along the Harricanaw?

Mr. KIERANS: This might well be. In any case, you mean that the materials will be there.

The CHAIRMAN: Dr. Hare, would you give us an outline of your part in this imaginative project?

Dr. F. KENNETH HARE (*Professor of Geography, McGill University*): My part is purely that of a commentator in one of the aspects of the scheme. I have been consulted by Mr. Kierans I suppose for a maximum of two hours in all, and I have read the brief. I imagine that he did that because he thought I had some expert knowledge of some of the area and of comparable programs.

I have recently completed a fairly elaborate survey of the surface conditions in the part of the area in the province of Quebec for the Department of National Defence, so I do know something of the physical circumstances involved—and I know something about the more general question of the water levels.

On the more general question first: I think the problem with which you are confronted, gentlemen, is the simple one of whether you wish to change what has always been our standard position in this country, which is that we should resist any attempt to divert water from the Great Lakes.

As you all know perfectly well, the Chicago demand down there has been one that has been going on for many years—I could almost say, generations—because they have an old river bed there which makes it possible for them to make a very easy and rapid diversion. Their attempts to withdraw water from the lakes have gone as high, I believe—perhaps some other witness could give you a better figure—as 15,000 cubic feet per second; and other communities around the lakes have also made similar demands. It has always been Canada's position, I understand, that we should resist these demands, because they affect the water levels in the Great Lakes system.

What Mr. Kierans is proposing, it seems to me, is to make possible such withdrawals on a rather larger scale than any that have been envisaged so far, without, as a result, affecting the water levels of the Great Lakes. So this is purely a political question, upon which I do not feel competent to express any opinion.

It is, however, quite clear that you cannot make any withdrawals from the Great Lakes in appreciable quantities without diverting a flow of water into them from other sources, and Mr. Kierans is perfectly correct in saying that so far measures to this effect have been the purely minor ones, the Ogoki one up here which feeds water into Lake Superior.

The proposal which Mr. Kierans has put forward interested me a great deal when I heard it, because it is indeed true that the Great Lakes have no natural source of water other than their own surfaces, plus a very small catchment area. It is quite remarkable that these very large lakes, which are among the world's largest and deepest in some cases—Lake Superior is—have almost no catchment area to feed them and no water systems flowing into them. They

are on the continental height of land between Hudson bay lake and the gulf of Mexico. So with the natural slope there is no possibility of increasing the flow into these lakes except by diverting water into them from one of the continental watersheds.

As Mr. Kierans has pointed out, the James bay basin is quite remarkable in shape. It does, in fact, collect a very large part of the drainage of the whole Canadian shield.

The area to which he has referred is, as far as I can say, about 250,000 square miles. And, there is a further point: about 60,000 square miles actually drain into a very small area between the mouth of the Moose and the Abitibi near Moosonee and the Rupert, which is a total distance of approximately 70 miles. Between this there are several major streams—the Nottaway, the Bell and the Harricanaw, which drain the whole area of the 60,000 square miles.

Into this 60,000 square miles, a great many streams converge. As I am not an engineer, I am not an authority as to how much water this represents; but, at any rate, on the Quebec side the yield per square mile per annum gets as high as 1.8 cubic feet per second on this side; and probably lower, perhaps 1.5, on the East Main slope. So, there is represented in this 70-mile area the collection of something like 80,000 to 100,000 cubic feet per second, all within a 70-mile distance of the starting point on Mr. Kierans' plan. This means that while he may be able to provide his water initially from the Harricanaw, he will probably have to go across the 30-mile muskeg area between the two rivers and pick up water from the Rupert, Nottaway and the Bell, which cut down here. Other than that, I agree with his choice of route. The magnitude of the figure of 27,000 cubic feet per second, about which he was talking, strikes me as being only about one-quarter of the water that is, in fact, easily available if, by "easy" you mean that you are willing to construct works to collect the flow of these streams. It is unreasonable to assume that you can do this unless you get across this stretch of land and pick up the Rupert, the Nottaway and the Bell.

The second point which I would like to make is with respect to the profile he has presented you of the Harricanaw itself. You have a profile in your brief. It is a very simple profile. The Harricanaw appears to have a flat section at its mouth which is 40 miles long, and it climbs 800 feet in a distance of 35 or 40 miles. There is another flat section up here referring to the profile. This is typical of all the streams around the east side of James Bay; they all do this. They all flow on a flat plateau, come down a steep series of falls, and reach a large flat section on the coast. However, northern streams, like the Great Whale, practically fall into James and Hudson Bays. At the other end there is this profile. He is proposing that the power potential represented by the fall of each of these streams, is going to provide a means of getting the water back up. Although I am not an engineer, there is a major engineering problem here. The problem is how to get the water up that slope.

Those are the only technical comments that I can add to what Mr. Kierans has said.

In regard to the more general question of whether or not diversions of this kind are, in fact, realistic, it quite obviously depends on a variety of political questions. As you are politicians and I am not, I will avoid these questions. However, it also involves these technical questions.

First of all, the diversion of water on a large scale into restricted watersheds is not at all a new idea; it has been done in many parts of the world, and I am sure you have heard about it. I believe you heard something of the Great Valley project, which involved the taking of water from the northern part of California into the southern section. This project is of a scale much smaller than this. Then there is the Snowy Mountain project in Australia,

which concerns the diverting of water from the Pacific slope into the interior through a tunnelling system. This is a very large enterprise, and the capital expenditures are very high indeed. A small project is the Jordan river in the holy land—the ultimate proposal being to move the rainfall excess from the hills of Syria and Lebanon around the corner via the plains of Jezreel to the Negev. There are many others, but I think the project which Mr. Kierans has proposed is the largest. I will stop at that point, Mr. Chairman.

The CHAIRMAN: Are any of those other diversion projects, of which you spoke, pumping projects?

Mr. HARE: Yes, they are, but not on this scale. Although I am speaking from memory, in the case of the Jordan valley, the water has to be pumped out of a trench, which is very close to sea level, and then up around the corner to the hills of Judea—and the figure of 200 feet sticks in my mind. In the case of the Sacramento project in the Great Valley, precisely what Mr. Kierans is suggesting is being done. The flow of the San Joaquin river south of San Francisco has been reversed, and the old channel has been used to carry Sacramento water southward. In other words, the net flow into the basin has been reversed. This involves a pumping procedure, but not on a large scale. None of them has climbed as high as the 900 feet, which is involved in the present case.

Mr. AIKEN: Mr. Hare, you have mentioned that we have a tremendous project, which is larger than any that have been undertaken previously, and that we have a tremendous answer to that problem. But, have we a tremendous problem to start with?

Mr. HARE: I think probably we have.

When I received a request to appear before this committee, I was miles away from my office, and I have not returned to gather data.

It is my impression that a very large proportion of the industrial areas on the American side of the border, at this location, are at the point where they cannot envisage any new large industrial water sources. Certainly, the continuous pressure from the state of Illinois encourages this point of view. I am quite satisfied that all through the flatter areas of the middle west on the southern side of the line there are areas where ground water sources have led to a serious depreciation of the ground water level, which adds tremendously to the cost of getting the water. While a perfectly feasible diversion channel exists, there is the question of the legal right to divert it. I could not say how big they are without doing a bit of work; however, I think it is a question for an engineer rather than for a mere scientist.

Mr. KORCHINSKI: Does this become a problem more for the United States than for Canada?

Mr. HARE: Yes. That is a problem which they cannot possibly solve themselves; and our attitude so far has been that we will not envisage or support any solution which envisages the diversion of Great Lakes water.

Mr. KORCHINSKI: Could you comment on when Canada would be faced with a problem similar to that?

Mr. HARE: It does exist already, but on a smaller scale by American standards rather than by our own.

In southern Ontario, particularly in the London district, and in some other places in southern Ontario, I think I am right in saying that large industrial water resources are hard to come by. I believe one or two Ontario towns have had to seek authority to withdraw Great Lakes water for their purposes.

If the need does exist in Canada, it is in southern Ontario.

Mr. MARTEL: As you know, natural resources, as Mr. Dumas mentioned a while ago, come under the jurisdiction of the province—and this includes

water, hydro and electric resources. To my mind, this is one of the major problems, and the costs should be settled before a complete study of the project is undertaken.

Now, you also mentioned—as the other members of the committee have asked you—the other major problem to settle is the question of selling the water.

As I understand it—and Mr. Kierans also said a few words on this—the needs of the northern states around the Great Lakes are established, and there is no question about that. Mr. Kierans mentioned that Chicago, or Illinois state, is going to take what it needs, no matter whether they come to an agreement or not.

Mr. KIERANS: I said they have threatened they would do this, but, so far, the other states have prevented their doing it.

Mr. MARTEL: They might eventually succeed in getting some kind of permission from the government. If they did, they could do it without paying for it. That would mean we could not sell the amount of water diverted from the north.

Mr. KIERANS: This would naturally include an international agreement.

Mr. MARTEL: I wonder if you could tell the members of the committee here why the Department of National Defence is interested in that problem, or in the area of waters? I do not know if that could be mentioned.

The CHAIRMAN: If it is considered classified information, I do not think you should answer that.

Dr. HARE: I have a contract with the Department of National Defence, which is a classified contract, Mr. Chairman. The work I have done has not been concerned primarily with waters, but one of the by-products is.

Mr. MCGREGOR: Who owns this water? Does the water belong to the federal or the provincial government?

Mr. KIERANS: I would say the water belongs to the province. The navigable streams belong to the federal government.

The CHAIRMAN: Mr. Cote could probably answer that question.

Mr. E. A. COTE (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): In the past I have tried to avoid the constitutional problem, Mr. Chairman.

To my way of thinking, it would appear the ownership of the water, as such, resides in the provinces. However, there is a distinction to be drawn between legal ownership and the legislative right over the use, or certain types of uses of the water. In that specific field the legislative jurisdiction is split between the federal and provincial governments. For example, the federal government has a legislative authority over the navigational use of waters.

Mr. KORCHINSKI: For example, if the water were diverted from the Abitibi, through the Harricanaw, into the Great Lakes, who would own that? Originally, that water would start in Ontario, would go into Quebec and then back.

Mr. COTE: It may not complicate the ownership any more than it is complicated now, because it would follow the same channels, in reverse order.

The CHAIRMAN: Are there any other questions for Dr. Hare?

Mr. MITCHELL: I want to ask Mr. Evans some questions.

The CHAIRMAN: Thank you very much, Dr. Hare.

Mr. Evans is with us, and Mr. Mitchell would like to ask some questions.

Mr. MITCHELL: Mr. Evans, I understand there have been some suggestions made by the committee as to the reception or rejection of this plan, as far

as the various states in the northern part of the United States are concerned. I understand that some states are objecting to the Chicago water steal; and the Illinois group, I believe, are in favour of it.

I am led to believe that you have recently been in touch with the necessary authorities in some of these northern states, and that you have made a visit to Washington. Could you enlarge on that?

Mr. EVANS: When I saw the possibilities of the Kierans plan, knowing the Chicago water diversion had been a perennial problem for generations, as Mr. Kierans said, and knowing that before the senate foreign relations committee at this time there is pending what is known as H.R. No. 1—that is the first bill brought before the house of representatives this year—the house of representatives has already passed this bill which permits Chicago to take another thousand cubic feet of water per second from Lake Michigan, or from the Great Lakes, as you refer to them. At the present time, Chicago is taking 1500 cubic feet a second for its sanitary and shipping purposes. In addition to that, it is taking another 1800 cubic feet a second for domestic purposes—which makes a total of 3300 cubic feet they are taking right now. Now, as I say, they want to add another thousand.

It is an international problem and a political problem. Canada opposes this diversion, even as it exists today, and certainly opposes any further diversion. The six states other than Illinois—New York, Ohio, Pennsylvania, Minnesota, Wisconsin and Michigan—also oppose it.

As this bill stands before the Senate foreign relations committee—it has been bottled up for several months now, and was coming up for consideration last week—I thought this Kierans plan might prove to be the solution for them. So I took it down there and talked to the people involved—such men as Senator Wiley of Wisconsin, who was one of the most vociferous opponents, and Senator Paul Douglas of Illinois, who supports it wholeheartedly. I also talked to Senator Fulbright, the chairman of the senate foreign relations committee, about this problem. Necessarily, they were all interested in this possibility as a solution, and also the possibility that they might get rid of this problem once and for all. It would work both ways. If it went through, Illinois would be permitted to take the additional water, and the other states would interpose no objection, because flowing down from the vicinity of James bay would be water to replenish the Great Lakes, thus solving the problem.

They have taken it under consideration, and I have received a telegram from Senator Alexander Wiley, whom I had contacted previous to coming here. I have not read the telegram yet, but I would like to read it now and put it in the record.

Mr. MITCHELL: Before you read that, was there a Canadian news dispatch circulated in Canada, apparently relating to a statement of Senator Wiley, with regard to his having been opposed to this plan? Apparently Senator Wiley denies this statement.

Mr. EVANS: That is right. I came back from Washington and told some members of the press what the reaction had been in Washington. I spoke of this in Ottawa, about how receptive they were to the consideration of this idea. Subsequently, Canadian Press published the story—I believe it was last Friday or, possibly, Thursday. That story, which had quite a wide distribution, was to the effect that Senator Wiley, in a sense, refuted, apparently, what I had reported his having said.

This astonished me, and we were in communication with Senator Wiley in relation to this. This telegram comes in response to the communication we had had with him over the week-end. So I do not know whether he refutes it still or not; or whether or not he is in favour of the idea.

Mr. MITCHELL: Do you want to read it into the record?

Mr. EVANS: I would like to read it for the record:

Robert Evans,
The office of Rodger Mitchell, M.P.,
Parliament Bldgs.

—and so on.

The senator says:

> I believe that the maintenance of adequate water levels in all of the Great Lakes is absolutely essential to the interest of the United States and Canada. Any proposal for resolving the present conflict with regard to the Chicago water diversion merits great attention. If the Kierans proposal described by you proves to be feasible and practicable —it may turn out to be one of the great cooperative Canadian-American undertakings. I have traditionally welcomed such cooperative undertakings—as my early support for the St. Lawrence Seaway will price. This new proposal, I believe, should be a matter for consideration beween the United States and the Canadian governments. The plan would need to be examined as to its feasibility, cost and practicability. Such examination will be more productive and important than the present proposal for a study of further diversion at Chicago—the harmful results of which are already known. I believe that we need to search for constructive means for resolving this Chicago controversy—and your proposal may hold the key.
>
> Signed:
>
> Senator Alexander Wiley.

So that would appear to be somewhat different from what had been reported.

Mr. MITCHELL: It would appear to be different from the press dispatch which was published.

Mr. EVANS: Yes.

The CHAIRMAN: Gentlemen, are there any further questions of Mr. Evans?

Mr. MCGREGOR: I move we adjourn.

Mr. DUMAS: Before we adjourn, Mr. Robichaud has a request.

The CHAIRMAN: It was brought to my attention. I believe Mr. Robichaud has a motion to put before the committee.

Mr. ROBICHAUD: Mr. Chairman, before I put this motion, it may be in order for the members of the committee to offer their thanks to Mr. Kierans, Mr. Evans and Dr. Hare.

The CHAIRMAN: Thank you very much. I am sure we are very grateful to you for having taken the time to come here today. There has been a good deal of public interest in this proposal and we are all interested in getting some of the background of it. We appreciate the effort you have put into enlightening us.

Mr. Robichaud has a motion.

Mr. ROBICHAUD: If it is in order, I would like to make the suggestion that the motion be placed on the record and left in abeyance until a decision is reached by the steering committee.

I move:

> That a report be presented to this committee on the investigation carried out by the Saint John river board.
>
> That the four members of the said board be invited to appear before this committee prepared to discuss:
>
> (*a*) Federal expenditures in connection with investigations carried out by the board.

(*b*) Share of expenditures by the government of New Brunswick or other agencies.

(*c*) Water storage facilities available from the Saint John river basin.

(*d*) Any other matters pertaining to the flow of the Saint John river and its tributaries as it relates to present and future power developments along the said river.

Might I add that I believe this motion is in order because an amount of $70,000 was included in the supplementary estimates for 1959-60 and in the further supplementary estimates an amount of $25,000. This comes under the water resources division of the department and I believe two of the witnesses already are employees of the department.

The CHAIRMAN: The motion is to the effect that this be referred to the steering committee for a decision.

Mr. ROBICHAUD: Yes.

Mr. DUMAS: I second the motion.

The CHAIRMAN: You have heard the motion. Are you ready for the question?

Motion agreed to.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 7

---

MONDAY, MAY 2, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESSES:

*From Department of Mines and Technical Surveys, Geological Survey of Canada Branch:* Dr. J. M. Harrison, Director, and Dr. V. K. Prest, of Pleistocene Engineering and Ground-Water Section.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22950-0—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.
and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, May 2, 1960.
(8)

The Standing Committee on Mines, Forests and Waters met at 11.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Coates, Doucett, Granger, Kindt, Korchinski, MacRae, Martel, McGregor, McQuillan, Nielsen, and Slogan.—(12)

*In attendance:* Messrs. J. H. Harrison, Director, Geological Survey of Canada; V. K. Prest and L. V. Brandon, Pleistocene Engineering and Ground-Water Section, Geological Survey of Canada.

*From the Department of Northern Affairs and National Resources:* Messrs. K. Kristjanson, Secretary, Advisory Committee on Water Use Policy and J. D. McLeod, Chief Engineer, Water Resources Division.

The Committee resumed consideration of the 1960-61 Estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

*Agreed,*—That a document entitled "Ground Waters in Canada" presented by Dr. Harrison to the Honourable Paul Comtois, Minister of Mines and Technical Surveys on November 25, 1957, be taken as read and included in this day's evidence.

Dr. Harrison was introduced and he summarized the document mentioned above, copies of which were distributed to members of the Committee.

Dr. Harrison was questioned, assisted by Dr. Prest.

Questioning concluded, the Chairman thanked Dr. Harrison for his presentation and then announced that Mr. T. M. Patterson, Director of the Water Resources Branch would discuss the work of the Fraser River Board on Tuesday, May 3rd. The Chairman also announced the various matters dealing with water resources to be discussed at subsequent meetings.

At 12.30 p.m., the Committee adjourned until 9.30 a.m. Tuesday, May 3, 1960.

M. Slack,
*Clerk of the Committee.*



22950-0—1½

# EVIDENCE

MONDAY, May 2, 1960.
11.30 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. I am sorry for the delay, but with so many meetings going on, and special meetings, our members are scattered all over the place.

We have with us today Dr. Harrison, director of the geological survey of Canada. He has given us an outline of what he is going to speak about here. I would ask to have these briefs distributed.

I understand that Dr. Harrison is just going to make reference to certain points in this brief. Is it the wish of the committee that we have it included in today's evidence, as read.

Agreed.

The Honourable Paul Comtois, November 25, 1957.
Minister,
Department of Mines and Technical Surveys,

*Ground Waters in Canada*

1. The pattern of our economy has been shaped largely by the availability and distribution of surface waters. Throughout the vast agricultural areas of Canada, however, and in many other areas, development has necessarily depended on the exploitation of waters occurring under ground. Many of these areas are subject to varying degrees of periodic drought and to other problems of inadequate or unsuitable supply. Furthermore, the overall need for new sources of supply is increasing steadily with the expansion of settlement and of industry.

2. Unlike surface waters, the existence of these ground waters can be determined only by systematic geological investigations. These investigations take time for the collection of the basic information and its interpretation. Such information is presently lacking for most parts of Canada. On this account the geological survey of Canada strongly recommends an early expansion of its work in this field. The survey has made limited investigations at various times since 1901 but, for lack of trained staff and sufficient funds, has been unable to provide coverage even in areas where the need is urgent.

3. Ground waters occur in water-bearing formations of the earth's crust (aquifers). An evaluation of these formations ordinarily is quite complex. The size, shape, depth, and capacity of the aquifers can be determined only by geological studies, supplemented by relevant information from test wells and from geophysical surveys. Water levels must be measured as a means of determining quantitative changes in underground storage, water-table maps must be prepared, areas of discharge and recharge must be determined, and much other pertinent information must be recorded. All these data must then be studied and compiled in usable form.

4. Because geological formations which offer potential sources of ground waters have no natural relation to municipal, provincial or

international boundaries, the consequent geological studies can seldom be localized within one jurisdiction, but ordinarily must be undertaken on a regional scale. This applies, for instance, to western Canada where, in spite of frequent droughts in the past, little is known of the availability of ground waters, and where water-bearing formations are likely to range over extensive areas.

5. Not only in western Canada, but throughout the country, similar problems exist and are awaiting attention and solution. It is essential, therefore, that, from the national viewpoint, action should be initiated to cope with the situation. The geological survey of Canada is the logical agency to assume such responsibility, as it is the central and major geological organization in the country. With the view, therefore, of arriving at a practical arrangement, the following suggestions are submitted for approval:

(a) The geological survey of Canada to make, or to act as consultant in, specific investigations of ground waters in areas where the federal government has direct responsibility, or has assumed responsibility through arrangements with the provinces. These investigations may be on a provincial, interprovincial or international level.

(b) The survey to make investigations of ground waters in those areas where more than one province is indicated to be underlain by the same water-bearing formation, the survey to incorporate in such investigations relevant data, if any, available from the provinces affected.

(c) To carry out these duties, the survey to be authorized to expand this section of its staff during the next five years to a maximum of 25 geologists, and to a maximum of 12 ancillary staff such as draftsmen, typists and clerks; this expansion to be in addition to what is considered normal for the branch.

(d) Consideration to be given, at the end of the 5 year period, to the possibility of sharing the cost with the provincial governments.

6. At a recent meeting of the advisory committee on water use policy it was stated that basic information on underground waters in Canada is required, and the opinion was expressed that the geological survey of Canada should obtain and correlate this information. To further explore the subject, a subcommittee was appointed, consisting of the director, water resources branch, Department of Northern Affairs and National Resources, the financial adviser to the deputy minister, Department of Finance, and the director, geological survey of Canada. This memorandum is based on the discussions of the subcommittee.

J. M. Harrison,
Director.

The CHAIRMAN: Dr. Harrison, would you mind proceeding with your contribution.

Dr. J. M. HARRISON (*Director, Geological Survey of Canada, Department of Mines and Technical Surveys*): Thank you, Mr. Chairman, gentlemen. The statement that you have before you was a brief that was submitted by me to my minister after consultation with the group representing the advisory committee on water use policy. This is a national committee. It was the general feeling that more ground water investigations were required in Canada, and a subcommittee was set up.

This brief to my minister is the result of the deliberations of that subcommittee. The minister submitted a modification of this to treasury on which the geological survey was then empowered to go ahead and carry out ground water investigations in various fields of Canada.

This had not been new. Ground water investigations in Canada began as early as 1901, but they never became systematic. They were sporadic, and from time to time, as national emergencies arose, ground water studies would be undertaken. I have a map here sketching the work that has been done on ground water studies in Canada. You can see, in the area that comprises Canada, what a small portion of it is actually covered by ground water surveys.

The reddish, or purple, area are maps that have been published by the geological survey of Canada. The parts coloured in orange are those in which geological survey work is in progress and for which maps have not yet been prepared; or, in the block in Alberta, work that was done a long time ago and was never published, but the data are available from the geological survey files. The uncoloured but stippled areas are those where studies have been made by provincial governments and for which only provincial data are available.

I might explain that this tremendous amount of work in southern Saskatchewan and in adjacent parts of Alberta was done during the drought years, 1935 and 1936—mostly in 1935. Virtually nothing was done from that date until a couple of years ago, when systematic investigations were recommenced —although we did have certain work done in Manitoba.

We have a total of eight parties this summer who will be undertaking investigations on ground water geology in the whole of Canada. Inasmuch as we have 10 provinces and two territories, this is pretty slim coverage. The number that we are aiming for in the geological survey—for the present, at any rate—would be about 20 ground water geologists.

According to the terms of references established by the advisory committee on water use policy, we will direct our activities to those areas where the federal government must assume responsibility because of territorial rights, such as in the Northwest Territories and the Yukon, Indian lands, and so on. Then to those areas where the federal government is putting in large sums of money—for example, in the Elbow dam in southern Saskatchewan—to those areas which border the United States and are therefore subject to international agreement, or to other areas where the water basin transgresses provincial boundaries and interprovincial arrangements may be necessary.

You may wonder why the geological survey of Canada is concerned with underground water. You have heard, of course, from meteorologists in terms of precipitation, and you have heard from the water resources branch of the Department of Northern Affairs and National Resources as far as surface water is concerned; and no doubt you will be hearing many more aspects of meteorology and surface water.

Once the water gets underground, it forms its own streams, or sources of water supply underground, known as aquifers. The places where this water travels is dependent entirely on the geological environment; that is, the porosity of the rocks, the general structure of the rocks underground. Without knowing the geology, it is impossible to predict or evaluate the potential sources of water buried beneath the surface. That is why the geological survey, since it is concerned with problems of geology, is concerned with hydrogeology— actually another branch of it.

Many of the provincial governments are greatly increasing their investigations in connection with ground water, especially, as you might expect, in the prairies provinces; but also in Ontario and in Quebec, as well as the maritimes.

The amount of ground water used in Canada, compared with that used in the United States, is relatively small. There are obvious reasons for this. There are more arid areas in the United States, much more industrialization, greater demands on power sources of surface water. I think perhaps in addition there is a compounding factor that, because of lack of water in certain restricted

areas, industry in Canada has not attempted to build up in such regions, and it is a matter of discovering sources of water which will enable industry to set up in areas which apparently do not have adequate sources of water.

I think any specific questions that may be in your minds might be better left for direct reply. I can leave the formal presentation of the remarks here, except to say we do not think that 20 people across the whole of Canada is enough to keep track of the supplies of underground water, to investigate new ones, or to try and provide the basic data on which others may be determined. But this is all that we intend as a first step, and there will be a re-valuation later.

I might also suggest that we badly need studies of surficial geology—Pleistocene deposits; that is, those deposits left by the great continental glaciers that cover virtually the whole of Canada. Canada is virtually unique in the world, in the extent of these unconsolidated deposits. Therefore, they have a very great bearing on the search for and evaluation of supplies of underground waters. Although in terms of our own organization Pleistocene geologists are not directly concerned with ground water, yet their studies are vital in the understanding of underground water and, if we do the good national job that I think groundwater requires, there should be an additional increase in the study of the Pleistocene deposits.

If there are any questions, I would be glad to answer them.

Mr. NIELSON: Dr. Harrison, do these aquifers which you have described have any international significance in a basin such as you have described, for instance, where part of the basin lay south of the 49th parallel and the other part north? Would the changing of the contour of the basin on one side of the border alter the underground water flow, for instance?

Dr. HARRISON: It could. I do not think that it would really be effective that way. A change in the use of the surface water might have a great deal to do with the amount of water that was available underground later on. The underground water, of course, comes from the flooding of surface drainage, the melt-water of snows and ice seeping down from permeable layers to get underground. Anything that was done to alter the surface drainage would have a serious effect on the amount of water contained beneath the surface.

There is, however, another point of significance in that connection. The surface drainage does not indicate the total amount of water that may be available, and when international agreements are based on water reserves or water supplies, such agreements should be based on the total water available. Unless we know the amount of underground water and the amount of surface water, such an agreement could not be reached.

An example I can think of offhand is the Souris river drainage area in southern Saskatchewan and Manitoba, which also loops through the United States. As you know, there is a certain amount of discussion going on at the moment as to the amount of water that can be used along this drainage, because there is not quite enough water. We have to consider the total amount of water available on the Canadian side of the 49th parallel so that proper adjustments can be made with the United States counterparts on the usage of water from that drainage area.

Mr. NIELSEN: Can you say whether in your opinion the proposed diversion of which the committee heard at its last meeting—or the one before that—north of the Great Lakes would prejudice the reservoir of water which would remain available for the development of further water resource industries in northern Ontario?

Dr. HARRISON: I do not really know, offhand. I would say it was not likely to have any deleterious effect on the water available in the south. If I recall correctly, I think you are referring to the proposed drainage across the height of land and back into the Lake Superior region—

Mr. NIELSEN: Yes.

Dr. HARRISON: —that would provide an added supply of water to the industrial areas. I doubt if it would have serious effects on any industry that we—or at least I—can see at the moment.

Mr. NIELSEN: Would it make any less water available in the north for the development of resources there?

Dr. HARRISON: Yes, it would. It would make less water available. However, at the moment, we do not see the need for the water in the north—for the kind of development that might be envisaged to use water.

Mr. NIELSEN: If the need was there in the north, or if the need was contemplated or foreseen in the north, would you say it would be prejudicial to that need?

Dr. HARRISON: Yes. You might take it as a rough rule of thumb that the amount of water used is an indication of the industrialization of the area, of the country, or the nation. So, if water is removed from a given area, it is going to reduce the industrial potential of that area. However, there might be overriding factors, which means that the amount of water taken away is negligible in relation to the other factors.

Mr. MACRAE: Mr. Chairman, I have one or two questions, which I would like to ask at this time.

When you use the expression "ground water geologists" I assume that is a specialized branch of geology?

Dr. HARRISON: Yes.

Mr. MACRAE: Dr. Harrison, your brief recommended that in the next five years the staff be increased to a maximum of 25 geologists. I presume you mean, for the most part, ground water geologists. I am referring to section C on page 2.

In the universities of this country—in Manitoba, at Queen's, and others, are any young men taking post-graduate work in ground water geology? They are taking hard rock and soft rock geology; but are there any bright young men, whom you would hope to get, taking this post-graduate work in the universities?

Dr. HARRISON: I do not believe there are any universities in Canada receiving students for post-graduate work in ground water geology. At one time Alberta had hopes of establishing such a course, but up until now it has not materialized. I do not believe there are any facilities for this in Canada.

Mr. MACRAE: Then, in that case, it would have to be a long range program, and you would have difficulty getting good qualified men for this work—unless you went south of the border.

Dr. HARRISON: That is true. We try to get graduates in general geology, who are interested, or have been interested in ground water geology during summer seasonal work. We bring them on our staff, and train them for one or two years. We give them our own post-graduate training. Of course, we are occasionally fortunate in getting someone who has had a good deal of experience; and we make good use of them.

Mr. MCRAE: I understand that you have now all the trained geologists that your finances will allow. Do you have more applicants for geologists on your staff than you are able to take? Are you getting applications from good young geologists?

Dr. HARRISON: Yes. As a matter of fact, competitions are set up to acquire one, two or three—a relatively small number of people—who are interested in this branch of endeavour, and the competition is closed as soon as satisfactory applicants have been obtained. It is difficult to say how many might have applied if the competition was left open.

Mr. McRae: Are you getting all you want?

Dr. Harrison: Yes.

Mr. McGregor: Your present staff is 20.

Dr. Harrison: No; that is what we are aiming for.

Mr. McGregor: What is your staff now?

Dr. Harrison: Nine ground water geologists.

Mr. McGregor: And you want 20?

Dr. Harrison: We would like to have about 20, yes. In the original submission the figure 25 is stated. We would like to have 25, but we could not handle 25 at the moment.

The Chairman: In your opinion, where is the greatest urgency for ground water studies in Canada?

Dr. Harrison: I think probably in the prairie regions. This is an anticipated need, but I think in the evidence that was given to you by the meteorology branch of the cyclical nature of precipitation, it looks as if we now have a peak in precipitation or, perhaps, we are past the peak. Such being the case, we can anticipate that there will be a shortage of surface water in the future. It would be wise to obtain basic information now on ground water resources before the shortage develops.

Mr. Aiken: Dr. Harrison, in the Parry Sound area I see there is a coloured section—and I cannot see from here whether it is one colour or two—where there is work now in progress, and work completed. Could you tell me about that?

Dr. Harrison: It concerns the southern part. This is the block.

Mr. Aiken: Yes, I see.

Dr. Harrison: The southern half is published; the northern half is in hand, and being published.

Mr. Aiken: Could you tell me why there is a special interest in this area?

Dr. Harrison: May I ask Dr. Prest to answer your question?

Dr. V. K. Prest (*Head, Section of Pleistocene, Engineering and Groundwater, Department of Mines and Technical Surveys*): Several years ago there was seemingly a need for the study of the Pleistocene deposits of the ground water in the Toronto region, and it was extended north into the Lake Simcoe-Parry Sound area. A lot of the work of the Toronto area was published but, in the northern part, only the surficial geology had been published. However, we have all the ground water data on file. In part, it was the assuming of industrialization to come and, in part, because it is such a populated summer resort district. There is local development along the highway, in some areas.

Mr. Aiken: I have a further question. Is this work being done partly on the Georgian bay waters, as well as inland?

Dr. Prest: This is inland—from Georgian bay over.

Mr. Aiken: I understand there is also a team working in the Georgian bay area. Would that be a different group?

Dr. Prest: Yes. The Ontario water resources commission are very active now in this field. Southwestern Ontario is their main working area. However, when they hear from these other areas, where there is a shortage of supply, the water resources commission put their teams in, and actually take it through to the drilling stage and the actual development of water.

Mr. Aiken: The reason I am asking is this. One of the previous witnesses was asked about the division of duties, and explained that the Department of Northern Affairs and National Resources was concerned only with the work on Georgian bay—that is, the water levels; and I assume this is additional work done by your department.

Dr. PREST: Yes.

Dr. HARRISON: Before we pass on to the next question, perhaps I should explain that in geological survey work we work as the federal agency; we do not do work of a nature which might be interpreted as development work in connection with municipalities, townships, and so on, who may wish to know the amount of water that is available. That would hardly come to the geological survey. They would approach first the provincial organization, who would be in possession of quantitative data. We supply the basic data upon which estimates can be made and on which some detailed studies may begin.

Mr. AIKEN: I have a further question, which concerns a slightly different line. Is the study of ground waters of any assistance in geological studies, as converse to your first statement?

Dr. HARRISON: I think geology, by and large, would come first; although I can well imagine certain conditions whereby the direction of movement of ground water, and so on, may give clues as to the geological conditions. For example, one of the important sources of underground water is the buried Missouri river channel. This is sought out mainly because of the source of water that it provides. By seeking them out as sources of ground water, they obtain information, of course, on the geology of the region.

I am not quite sure which comes first in this case, but there is an interrelationship which is practically impossible to get rid of.

Mr. AIKEN: But this particular branch is basically concerned with the water resources rather than geology.

Dr. HARRISON: No sir. The interrelation is so close that it is impossible to separate them. That is why we do it. We cannot understand the ground water without having the geology.

Mr. KORCHINSKI: Mr. Chairman, I would like to ask a question. Is this type of work primarily a federal responsibility, or does this involve, perhaps, some provincial responsibility? I ask this question because I notice in the *Financial Post* that Alberta has a team of six working. They set this team up in the last four years for the purpose of studying ground water levels, and so on.

Dr. HARRISON: Yes, the provincial governments have a very great responsibility in this field. Of course, they are responsible for the administration of water content within their provincial boundaries as a mineral resource, and they need to know quite a bit to properly control the usage of the water.

As I mentioned a moment ago, we are concerned basically with providing the information on which such detailed information can be made. Actually, in Alberta a great deal more is being done by the Alberta government than we could ever hope to do in Alberta, with our present establishment. Probably, this is the way it should be.

Mr. KINDT: In connection with your studies of ground water data, and the data you compile, do you take into consideration the quality of water as one of the factors?

Dr. HARRISON: Not directly. Of course, the utilization depends on this. The industrial waters section of the Department of Mines and Technical Surveys analyzes water samples for chemical content. I would suppose the Department of National Health and Welfare would be concerned with the bacterial content of the waters.

Mr. KINDT: From my experience, I should think that the quality of the water on the prairies is one of the greatest factors to consider for not only domestic, but industrial use. I am interested in getting your reaction.

Dr. HARRISON: Of course, we are interested in the quality of water, and any water that may be studied by our geologists would, of course, be studied from

that point of view—or, at least, information would be obtained, as part of the basic data we provide, in regard to whether it were alkali, sulphurous, and so on. I think the detailed analysis, and so on, would be the responsibility of the agent who is responsible for administering the water.

Mr. KORCHINSKI: Mr. Chairman, I was wondering whether any information could be obtained from any of these oil companies which are doing drilling work. Perhaps they could offer this information, without giving away any of their trade secrets. I was thinking, if they struck a water level so many thousand feet, or so many hundred feet, would it be possible for some department of government to compile it, through the cooperation of these oil companies. Has that been done?

Dr. HARRISON: The actual water levels of water-bearing horizons do not come directly from oil well drilling. There is so much mud goes down with the drill rods that sometimes, unless the water is very free-flowing, it might be quite impossible to determine at what level it is encountered. However, the character of rocks and materials encountered by the drill on the way down would provide very useful information on the possible sources of water, which could be followed up later. I think perhaps you are referring to the fact the Alberta people get a great deal of information from the oil companies, and they are intending to compile that information. This is being done—or is being considered, at any rate, by the Alberta people, and probably would also be investigated by the Saskatchewan research council as well. The federal government in the provinces does not get or attempt to get detailed drill records of the oil companies. We are concerned only with the so-called "wild cat" or exploratory wells which provide basic geological data in areas where little geology is perhaps known. But the actual field tests, the sort of thing the Alberta research council are considering using, are not given to the federal government, nor are they asked for by the federal government.

Mr. DOUCETT: This work you propose doing when you get your geologist, would it be overlapping the provincial work, or would it be cooperating with them?

Dr. HARRISON: It will be cooperating with them.

Mr. DOUCETT: There will be two different types of work done, one by the federal and the other by the provincial, and they will be coordinated, is that the idea?

Dr. HARRISON: Yes. Every year, when we first develop our field program, copies are sent to each provincial government with a request for comments. Very often there are changes made in this program because the provincial government may be working in an area where there is some overlap. At any rate, by the time the final program is settled there is no overlap between the two governments.

Mr. DOUCETT: This may be kind of a foolish question, but is it possible the provincial government might be out looking for something different altogether, and in a different area? What cooperation and coordination would there be there? For instance, take western Ontario now, with a great shortage of water there, and many other places I cannot think of at the present time, but some other places?

Dr. HARRISON: By and large, in the provinces we are working in those places where the provincial governments would like to have us do some work, for whatever reason. In some governments liaison is closer than in others; but by and large there is no duplication of effort.

Before I carry that too far I should say this: As I said before, we are providing, or are trying to provide basic data, not the quantitative estimate of water that may be available. So that it is quite possible the provincial

agencies would wish to go over the same ground we have gone over, but with a different approach in mind, or for the sole purpose of getting more quantitative information.

Mr. DOUCETT: Your information, is it for the reasonably foreseeable future of the development of a community, in the way of residential or industrial development? Do you compile it for the future?

Dr. HARRISON: It is to provide data we hope, at least, will be everlasting. On this data can be founded the development of communities, industrial sites and so on.

Mr. DOUCETT: It will be available for people to find out what really does exist in the way of quality and quantity, and so on?

Dr. HARRISON: Yes, that is correct.

Mr. KINDT: A supplementary question, Mr. Chairman.

In the various end uses of your data, are there any others, in addition to the ones you have already mentioned? Is it to give wider application for future development, industrialization, or the possibilities of settlement?

Dr. HARRISON: Yes, indeed. As a matter of fact, the article which has been referred to in the *Financial Post* indicates two very good examples of that, I believe.

An industry was, I think, set up in Medicine Hat, after the geologists were able to show there existed there an adequate source of suitable water for the industry they were contemplating. Had such water not been available there would have been no industry of that nature in Medicine Hat.

This could happen and will happen, unquestionably, in many other places, especially the prairies and other parts of Canada.

Mr. KINDT: On that Medicine Hat case—of which I happen to know something—they struck this underground stream of water in that particular industry, which was an extremely fortunate thing. If they had drilled a couple of feet one way or the other they might not have hit it?

Dr. HARRISON: It is not quite as fine as that. I am not quite sure which river it is, but it is a pre-glacial river valley which had been covered in by the continental ice sheet, and it formed a depression filled with gravel, on top of the bed-rock, which forms a natural place for the accumulation of water. By tracing this down—which can be done by geophysical instruments—it is possible to spot the drilled hole closely, to hit the centre of the gravel bed.

There are two questions really: Was it rock containing water; and secondly, was the water suitable? The answer was in the affirmative in both cases.

The CHAIRMAN: Dr. Harrison, is it mandatory for an oil-drilling company to furnish data to any government agency, geological data?

Dr. HARRISON: It depends on the provincial regulations in that instance. I believe in the provincial governments, by and large, it is mandatory that samples of the rocks cut by the drill and the logs made by the company people must be provided to the provincial government. It will be the same, I think in the federally administrated northern territories. But these drilling companies, drilling in the provinces, are not required to provide the data to the federal government, and the federal government agency—the geological survey—does not ask for it. As I mentioned earlier, we do ask provincial governments for certain specific information on certain wells. This is provided to us in all cases.

Mr. McGREGOR: Is this not more or less a provincial matter?

Dr. HARRISON: What is that?

Mr. McGREGOR: Is this not more a provincial matter than it is a federal matter?

Dr. HARRISON: That is, the surveying for ground waters?

Mr. McGREGOR: Yes.

Dr. HARRISON: On the whole, yes, but there are a great many places where it is in the national interest to have data available to the federal government. Some of these instances are outlined in these submissions you have in front of you.

Mr. KORCHINSKI: Dr. Harrison, you mentioned that samples must be submitted to the provincial government or the federal authorities; and yet you did not mention anything about the results of seismographic tests. I do not know whether any regulations are in effect which compel those companies to give you results, or not, but in this particular article I just want to read one statement:

> Working from likely spots, indicated by the mosaics, seismic crews take over detonating electronic charges that bounce off underground formations.

That would indicate the result of seismic tests would be helpful in determining this information.

Again I say, if some cooperation could be worked out with some of these companies I think a lot of that information could be obtained very readily. Is there anything being worked out to that effect now?

Dr. HARRISON: Very definitely. There is a great deal of geophysical information, not only seismic information, but magnetometer work, electrolog, electrical resistivity, and various other methods are all being utilized by the government agencies in order to try to get more basic information on the potentials of ground water.

As a matter of fact, this is what I was referring to a short time ago when I said people at the Research Council of Alberta were contemplating the compiling of a lot of this information to put out as a basic study for the southern part of the province of Alberta.

Mr. KORCHINSKI: This would indicate the government is doing that type of work, whether it is provincial or federal, but it does not indicate whether there is some information that is available from some of these oil companies that perhaps they have already. You could not possibly obtain that for me?

Dr. HARRISON: A great deal of it is obtained from oil companies. I could not say whether it is through legislation or voluntarily, but I know a great deal is turned in by oil companies.

Mr. KINDT: On that question of availability of information to the public—and this is somewhat personal—on my particular farm I intend to drill a well this summer, if I can. Up to now, I have not any information except a local fellow with a willow rod. I would like to have a little more scientific data on it before I spend $2,000 for a well.

Dr. HARRISON: I assume your farm is in Alberta.

Mr. KINDT: That is right.

Dr. HARRISON: I suggest you get in touch with the research council of Alberta and ask for any assistance they might give you over the possibility of developing a well on your farm. They have a staff that looks after requests of this nature.

Mr. KORCHINSKI: Is there any such service available in Saskatchewan?

Dr. HARRISON: Yes, the research council of Saskatchewan, in Saskatoon.

Mr. AIKEN: I would like to ask Dr. Harrison several questions in relation to downstream benefits.

Mr. SLOGAN: First, I wonder if I can ask a question on this divining willow rod. Is there any scientific basis for it? I know it works because I have tried it.

Dr. HARRISON: There is no scientific basis for it. There have been objective tests made by individuals who have proven to be able to determine the presence of water by the use of a willow wand, or various such devices. Objective tests of this nature failed to disclose any significance, you might say, to the deviations that a willow wand goes through.

I asked our officers at one stage, what to say about this. One was quite prepared to come here with a willow wand and make it work any place, anywhere.

Mr. MCGREGOR: I would like to ask a question. Supposing one wanted to find out, instead of getting a fellow with a willow rod, he will go to you long-haired fellows to ask you. Just how would you go about deciding whether there was water there or not? What would you do?

Dr. HARRISON: In many instances there would not be sufficient information available to let you know or make an intelligent guess. In other areas the background of geological information would be sufficient to be able to tell you quite definitely whether or not you would get water, what the quality of it might be and the depth at which it could be obtained.

Mr. MCGREGOR: For instance, I know different places, not too far from Toronto, where men interested in putting in subdivisions would have to go and drill holes to try to find out where they would get water. Surely, if there was any way for them to know or somebody they could go to, to get this information, they would not be drilling holes? Why are they drilling holes if there is somebody there to tell them where the water is?

Dr. HARRISON: In this particular case I am not familiar with the background. It is quite possible if there is not information available on which interpretations could be made the best you can do is make a guess—let us say intelligent guess—as to whether or not it might be there.

Mr. AIKEN: If it concerns what might be known as downstream benefits in connection with underground waters, am I correct in believing that underground streams come to the surface in most cases.

Dr. HARRISON: I think eventually they must come to the surface.

Mr. AIKEN: If that is the case I wonder what effect the tapping of underground water in one particular location, such as Medicine Hat, would have on the ultimate place where this water comes to the surface? Have sufficient surveys been made as yet to hazard any guess as to the result of such a tapping.

Dr. HARRISON: It must have an effect I should think, but I am afraid I could not tell you what sort of effect it might have except in terms of perhaps the overall quantity. I believe that the amount of ground water being used in the whole of the United States today is about the equivalent of the flow of the Ottawa river below the junction with the Gatineau river. This is a large amount of water, but when you spread that over the whole of the country the amount it affects any one drainage would be very small.

Mr. AIKEN: Perhaps if a large area undertook to tap an underground water it might deprive some place further downstream of their water supply.

Dr. HARRISON: It could.

Mr. AIKEN: Such as surface water.

Dr. HARRISON: It might indeed. This is why the whole drainage basin should be studied as a unit.

Mr. AIKEN: Then with knowledge of the volume, the direction, and so on you then would be able to determine whether or not there would be any effect and how much water could be drawn.

Dr. HARRISON: Yes.

The CHAIRMAN: Do you have sufficient information to know what effect if any the new Saskatchewan river reservoir will have on ground water levels in the surrounding area? Will it increase them?

Dr. HARRISON: Perhaps Dr. Prest could better answer that question; in fact I am sure he can.

Dr. V. K. PREST (*Pleistocene Engineering and Groundwater Section, Department of Mines and Technical Surveys*): Due to the character of the shale beds in the basin we do not think it will have any great effect on the immediately surrounding areas that might take in water from the shale. Most of the water in that area is taken from very shallow water in the drift. It will supply a lot of water which may be used for irrigation below the dam and this will affect the ground water level in the irrigated areas.

Mr. McGREGOR: A moment ago you said this underground water must come to the surface some place. Is there any place in Canada where you know these underground waters come to the surface?

Dr. HARRISON: Any spring has its source as an underground creek. Perhaps part of the water escapes through a crack to the surface. Most of the underground waters in this country gradually slope down to the surface levels, come up and leak out. There is no one particular spot which you can say is the place the underground water is escaping.

Mr. McGREGOR: You do not know of any spot.

Dr. HARRISON: I cannot think of any at the moment.

Dr. PREST: All underground water does work its way down grade and supplies our rivers. A large part of our present day river supply is from underground water. When we say these waters come out on the surface we mean they leak out, normally in the valleys, and feed rivers.

Mr. McGREGOR: I understood we were speaking about underground rivers and that they do come to the top some place. Is there any place in Canada they do come to the top?

Dr. PREST: Not as a distinct river.

Dr. HARRISON: By coming to the surface I meant joining surface water drainage. From the north and the south a great many would leak out in the Great Lakes somewhere below the surface of the lake itself.

Mr. McGREGOR: Have you any measurements to show the extent of these underground rivers, how deep they are, or how they are formed?

Dr. HARRISON: The water that falls on the surface of the earth as snow or rain seeps down through the ground and if there is porous strata such as gravel, rocks or open sandstone, the water will follow that porous layer as far as the layer travels. If it gets down far enough it will become reheated and reappear in the form of hot springs. For instance, most of the water in the hot springs in the mountain area is derived from underground waters of this nature. Very little water is actually accumulated from the molten rock beneath.

Mr. McGREGOR: It is not an underground river such as we see on top of the ground. It is a river which just runs through loose gravel and stone.

Dr. HARRISON: It is not the sort of thing on which one would sail in a boat.

Mr. McGREGOR: It just seeps through gravel.

Dr. HARRISON: Yes.

Mr. McGREGOR: What use has been made of that water now, to your knowledge?

Dr. HARRISON: There have been tremendous useages of it, especially in the arid regions of the south-western United States. In fact in the whole of the U.S. prairie region the foundation of the economy is the underground water.

Mr. MCGREGOR: There has been no use made of it in Canada as yet?

Dr. HARRISON: Yes; but not to the same extent.

The CHAIRMAN: Do you envisage the eventual solution to the domestic water problem in southern Alberta and Saskatchewan by an underground water study?

Dr. HARRISON: As a solution to the existing problem, yes; but as soon as the area becomes attractive by reason of more knowledge of the water, more people move in and the problem recreates itself. I think it will be a never ending problem from that point of view.

Mr. KINDT: You mean the supply becomes diminished?

Dr. HARRISON: No, but the number of people making demands on the supply increases to the extent that the known amount available is getting smaller and smaller.

Mr. DOUCETT: Which will lower the water table.

Dr. HARRISON: Actually it could remove it entirely.

Mr. DOUCETT: Is that taking place in many sections at the present time?

Dr. HARRISON: Yes.

Mr. DOUCETT: Do you know of many wells which go dry due to the extra demand made on the community because of wells, irrigation or other purposes? A certain number of wells at a certain level go dry and have to be deepened or drilled anew. That has happened in the community in which I live in some cases. I am wondering whether or not that is because of the lack of rainfall or the amount of snow to feed those areas; or is it over-use whether commercial, domestic, or otherwise?

Dr. HARRISON: Both factors are serious considerations; that is, the over usage and drought in years when there is not sufficient precipitation to replenish the reservoir.

Mr. DOUCETT: If the tables goes down you hear people say that it is much lower than at a certain time; but it does come back up when you get surface water in the form of snow or rain.

Dr. HARRISON: Yes, a certain amount; but it can be too much of a strain on it. I remember reading that in California the water table had fallen 360 feet due to pumping out for irrigation. This is a very serious thing.

The CHAIRMAN: Are there any other questions of Dr. Harrison?

Dr. Harrison, I thank you very much for your presentation.

We should have another interesting meeting tomorrow. Again we will have with us Mr. Patterson of the water resources branch to discuss the work of the Fraser river board. That is of particular interest to British Columbians. This board has been performing some very interesting studies there, one of them being the problem of fish versus power, and also flood control.

I will give you a brief outline of what we have on the agenda for the meetings ahead. Next Monday we will have Mr. J. R. Menzies of the Department of National Health and Welfare and Dr. A. B. Berry, general manager and chief engineer of the Ontario water resources commission, to discuss the pollution problems in Canada and in Ontario. On Tuesday, we will have Mr. Richardson, the chief of the conservation branch of the Department of Planning and Development of Ontario to discuss water conservation.

We have the meetings ahead pretty well lined up. This will give you an idea of what is on the agenda for the immediate future.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 8

---

TUESDAY, MAY 3, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESS:

Mr. T. M. Patterson, Director, Water Resources Branch, Department of Northern Affairs and National Resources.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

22991-4—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, May 3, 1960.
(9)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Baskin, Cadieu, Doucett, Dumas, Gundlock, Hicks, Kindt, Korchinski, MacRae, Martel, Martin (*Timmins*), McFarlane, McQuillan, Mitchell, Muir (*Cape Breton North and Victoria*), Payne, and Robichaud—(17).

*In attendance:* Messrs. E. A. Côté, Assistant Deputy Minister; T. M. Patterson, Director, Water Resources Branch, and K. Kristjanson, Secretary, Advisory Committee on Water Use Policy, all of the Department of Northern Affairs and National Resources.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Mr. Patterson was introduced and he made an extensive statement outlining the responsibility and work of the Fraser River Board and its study of the water resource development and flood control problems of the Fraser River basin in British Columbia.

During his presentation, Mr. Patterson emphasized various points by the use of slides.

The questioning completed, the Chairman announced that Mr. J. R. Menzies of the Department of National Health and Welfare, and Dr. A. E. Berry of the Ontario Water Resources Commission would appear before the Committee on Monday, May 9 to discuss pollution problems. The Chairman also announced that, if possible, a discussion on Saint-John River Board matters would be held on May 17.

At 11.00 a.m., the Committee adjourned until 11.00 a.m. Monday, May 9.

M. Slack,
*Clerk of the Committee.*



22991-4—2

# EVIDENCE

TUESDAY, May 3, 1960
9:30 a.m.

The CHAIRMAN: Gentlemen, we have a quorum. As I outlined to you yesterday, we have Mr. Patterson with us this morning to discuss the work of the Fraser river board. Mr. Patterson, I understand, is the federal representative on that board. Is that correct, Mr. Patterson?

Mr. T. M. PATTERSON (*Director, Water Resources Branch, Department of Northern Affairs and National Resources*): I am one of the federal representatives. There are two federal representatives, one from the Department of Fisheries and one from our department.

The CHAIRMAN: Would you proceed, please, Mr. Patterson.

Mr. PATTERSON: Mr. Chairman, members of the committee: It is proposed to present to you today an outline of the responsibility and work of the Fraser river board in its study of the water resource development and flood control problems of the Fraser river basin in British Columbia.

At a later point I propose to show some views on the screen. I must apologize, because some of the pictures do not show up too well on this screen. They are 35 mm. pictures, and unless the room is very dark they do not show up too well.

Proposals for a federal-provincial study of the Fraser river had been initiated in 1947. The need for a comprehensive investigation of the river basin from the point of view of resource development and flood control was severely emphasized in 1948 when the river went on a flood rampage with disastrous results to many people and interests in the valley. Immediate emergency measures were taken to protect and rehabilitate the lands and dykes which had been damaged and with a view to developing a higher and more permanent degree of protection the two governments appointed the dominion-provincial board, Fraser river basin. The board consisted of ten members, five appointed by each government from its departmental officers and the governments agreed to share equally the cost of a survey and report on the water resources and requirements of the area comprising the Fraser river watershed. Chairmanship of the board was vested in the federal Department of Public Works.

In 1954 responsibility for the federal participation in the Fraser river studies was transferred from the Department of Public Works to the Department of Northern Affairs and National Resources. The earlier terms of reference and the progress of the board were reviewed and in discussion with the government of British Columbia a decision was reached that the terms should be made more definitive and that the board should be reduced in size. Accordingly the dominion-provincial board, Fraser river basin was disbanded and the Fraser river board was appointed, with new terms of reference, in May 1955. The new board in its first year was to consist of six members and thereafter of four members appointed by the two governments in equal numbers. Chairmanship of the board alternates between the federal and provincial sections annually. The two federal members are from the Depatrment of Fisheries and the Department of Northern Affairs and National Resources respectively. The provincial members are from the Department of Lands and Forests.

The terms of reference required that the board submit an interim report on flood control by 30 June, 1956, and a preliminary report on its findings with respect to the effective regulation of the river system for flood control and power and the resultant effects on navigation, fisheries, silting, erosion and irrigation not later than 30 June, 1958. These reports have been filed with the governments and it is with respect to the findings presented therein that much of this talk will be directed. However, I should add that the investigations have not stopped with the 1958 report. In 1959 the governments drew up new terms of reference extending the life of the board to 1963 and empowering it to "plan, supervise, and carry out such surveys and investigations as may be needed to prepare a comprehensive report dealing with the engineering and economic feasibility of a partial hydro-electric power development of the Fraser river that would provide flood control on the Fraser river to the extent considered necessary in the aforesaid 'Preliminary Report'". These studies are proceeding expeditiously.

*The Fraser River Basin*

As may be seen from this wall map, the Fraser River basin, with a total area of 90,000 square miles, lies almost entirely in and comprises one-quarter of the province of British Columbia. When I say "almost entirely in", there is a small section here that extends south to the international boundary line, and that comprises 117 square miles of the total 90,000 square miles. This represents an area a little larger than the whole of Great Britain and about the same size as the combined areas of the four maritime provinces excluding Labrador. The basin extends from the 49th parallel to beyond the 56th parallel of latitude and to the east it reaches a section of the Alberta boundary thus incorporating a portion of the Rocky Mountain trench.

The Fraser river rises in the Rocky mountains in the vicinity of the Yellowhead pass. Its initial course is north-westerly for some 300 miles, the last 250 of which are in the Rocky mountain trench. Near Prince George it leaves the trench and flows almost due south for 400 miles through the interior plateau. At Lytton it cuts through the Coast mountains in the Fraser river canyon to Hope where, nearly 100 miles above its mouth, it enters an alluvial valley which it follows to the sea.

At this point I think we might have the room darkened. This slide is a repetition of the map which is on the wall. It demonstrates very clearly the shape of the basin. Stuart river comes into the Nechako at this point.

In the 850 miles of its length the Fraser river is joined by such important tributaries as the McGregor, Bowdon and Willow above Prince George. The McGregor comes in here and the Bowdon comes in above Prince George. It is joined by the Nechako with its northern tributary, the Stuart at Prince George; the West Road, Quesnel and Chilcotin rivers; the Bridge river near Lillooet; the Thompson river at Lytton and the Lillooet river near Chilliwack.

Shown on this map is the area of the Fraser River basin which was diverted to the ocean at Kemano for the development of the aluminum company. The Kenny dam is located here.

May I have the next slide please. The profile of the Fraser river indicates that it has its source at elevation 6000. Much of the fall takes place in the mountains before the river reaches the Rocky mountain trench. It drops down through Moose lake here in a sharp descent into the Rocky mountain trench. The slope is fairly uniform in the upper reaches down to Prince George. When it gets past Hope it flattens into a tidal section.

This picture shows the various tributaries. This is the Fraser river itself at its source passing Prince George down to Hope and on to the ocean. This shows the McGregor river coming in at Prince George. This is the Stuart

river, a tributary of the Nechako. This shows the Kenny dam here with the reservoir at that point. Here is the West Road river, and the Quesnel river with its tributary, the Cariboo. There is a very steep slope in the Cariboo. The Thompson river is here with the south Thompson and north Thompson at Lytton. This is the Chilliwack river at this point.

While the basin is situated within the American cordillera and includes some of the Coast, Columbia and Rocky mountains, it embraces relatively few high mountain peaks. The relief map illustrates the distribution of the basin land according to elevation. These red areas are the higher land and the small sections in white are the high peaks. The green here is down in the plain at the mouth of the river. You will note that in all this area in here there is not much relief. That constitutes the interior plateau area.

In elevation the basin extends from sea level to Mount Robson's 12,972 feet. However, the chart on the screen offers a more interesting picture of the relation between area and altitude in the basin. It may be noted that only 6% of the area is below elevation 2,000 and only 10% is above 6,000 feet, but what is probably more important over 70% of the basin is above elevation 3,000, the approximate maximum elevation of existing agriculture.

Much of the basin is contained in what is known as the interior plateau which has an area of 46,160 square miles. This comprises two smaller plateaus, the Nechako in the north and the Fraser more southerly. On the other map I pointed out the interior plateau. It comprises this area here. The Nechako plateau averages about 2,500 feet above sea level and contains only a few rounded mountains exceeding 5,000 feet. The Fraser plateau although further downstream is roughly 2,000 feet higher than the Nechako, with the result that you have the river flowing through very deep valleys.

The climatic factors of the basin most closely related to the board's studies are precipitation and temperature. In both of these there are wide variations. As shown on the screen one relatively small area not far from Vancouver produces an annual precipitation of over 150 inches while in the vicinity of Kamloops the annual precipitation is less than 10 inches. So there are very dry areas in the interior here as those of you who come from British Columbia are well aware.

Large expanses of the interior plateau receive less than 20 inches of precipitation per annum due to the rain shadow which the Coast mountains cause against the moisture laden winds from the ocean. I do not know whether or not you can see the smaller charts here, but they demonstrate the effect of the Coast mountains on the precipitation. A profile of the land elevation is shown through here with the precipitation which occurs. Here when you hit the first range of mountains the precipitation goes up and dips when you come in here. When it hits the high coast range the precipitation goes up and falls off on the east of these mountains and there is very little precipitation in the valley in between. When the winds hit the Rocky mountains again the precipitation goes up again. At a point farther south a similar effect is shown. There is a high precipitation on the west side of the Coast mountain range and for each of the interior ranges the precipitation goes up and falls off on the east side again. When it hits the Rocky mountains it goes up materially at that point and then drops off.

The interior plateau comprising 57% of the basin contributes only 30% of the annual run-off. It is of interest to note that possibly as much as two-thirds of the precipitation in the basin is received in the form of snow. In winter, the northern part of the basin is dominated by cold, arctic air. At

times, cold waves extend south and occasionally penetrate the lower Fraser valley. In summer, temperatures are high in the deep southern valleys, but moderate over most of the plateau area.

Hydrologic studies and methods of flow regulation require extensive patterns of basic data recording points. The available data of the Fraser river basin left much to be desired for the studies and regulation for flood control, power and other purposes will require improved coverage.

There are some 86 active meteorological stations in the basin with only 49 of these located in the 87,000 square miles above Hope, or one station to each 1,777 square miles. Moreover, most stations have had to be located at the lower altitudes where attendants are available. Thus only 16% of the stations are above elevation 3,000 whereas 71% of the basin is above that altitude.

From where you sit I do not think the locations of these stations show up very well. However, that is the situation. There are large areas of higher altitudes in which no stations are available in areas which contribute a great deal of the run-off.

Melting snow in the mountains contributes greatly to the flood discharges of the Fraser river in May, June and July. In consequence, systematic snow surveys can prove a great aid to forecasting the volume of run-off to be expected. There are 25 courses in the basin and more are needed but the provincial water rights branch performs a useful service through its operation of the existing courses and its forecasts based on the records obtained. The location of the courses is shown on the screen. I think that is showing up a little better. They are located in the higher areas of the basin.

The federal water resources branch with the assistance of the provincial government, private companies and other agencies maintains and operates the stream gauging program in British Columbia. Lack of hydrometric coverage, geographically, and short term of record are always problems in hydrologic studies. In the Fraser river basin there are some 70 continuous stream gauging stations of which 38 are only short term stations. By short term I mean they have been in existence for only a few years. The record does not provide the pattern which one should have for making hydrological studies. There are 31 other stations where only gauge heights or an occasional metering is obtained, and some additional stations are operated in the summer only for irrigation purposes. Nine stations have been operated for over 40 years. The locations of the stations are shown on the map. There is quite a mass of stations in the Fraser river valley.

It is not proposed to detail the technical studies on which the flood protection plans were based. A maximum flow of 536,000 c.f.s. was recorded at Hope in 1948 and such records as are available for 1894 indicate the maximum flow in that year was somewhat higher. This led to the adoption of 600,000 c.f.s. as the design flood at Hope under natural flows, but because of the Nechako diversion this has been reduced by 4% to 576,000 c.f.s.

The need for flood control stems basically from man's occupation and development of the natural flood plain of a river, as has happened at several points in the Fraser river valley, but particularly so in the fertile reaches below Hope.

In 1948 the river flooded 55,000 acres which is equivalent to one-third of the dyked lands or about one-quarter of the cultivated agricultural lands in the lower Fraser valley. About 2,000 homes in the valley were damaged and about 16,000 people were moved to temporary accommodation. Municipal services, communication, transportation, farm crops, dairy and stock farms, industry and business all suffered damage and loss. Areas of Kamloops, Quesnel and Prince George were flooded also.

Would you please turn the slide. This slide indicates the dyked and flooded areas in the lower Fraser valley. This designation which is shown here represents dyked areas which were not flooded. The colour does not show up on this slide too well. There were areas all through here and up there which were flooded.

May I have the next slide please. This shows the flooded area at Kamloops. The portion here shows the flooding in the 1948 flood.

May I have the next slide please. This is the area flooded at Quesnel.

The next slide. This is the flooded area at Prince George. The flooded area is shown there, and there is some more up here.

Immediately after the 1948 flood the governments of Canada and British Columbia established the Fraser valley dyking board and agreed to share the cost of repairing, strengthening, constructing and reconstructing dykes in the Fraser valley in the proportions of 75% by the federal government and 25% by the provincial government. In all, the board repaired, reconstructed or built anew over 163 miles of dykes, involving over 5,000,000 yards of material.

The Fraser river board gave consideration to four principal direct means of controlling floods i.e. by dykes, by flood retention reservoirs, by channel improvements and by diversion channels. It found that the first two would be much more effective in providing flood control in the lower Fraser valley. It found that the existing dyking system could be raised to contain the design flood maximum at a capital cost of $17,000,000 and an annual cost of $1,915,000, but it concluded that regulation resulting from storage operations in connection with power development offered favourable promise for study.

In its power studies the board developed three alternative systems for the basin. These gave firm energy of 5,089; 5,341 and 5,159 m.w.'s respectively for capital costs of $1,969 million; $1,988 million and $2,055 million, respectively. Each gave a benefit cost ratio greater than unity, but each involved a number of dams which might cause serious delay to the migration of anadromous fish and damage to the salmon industry. One of the systems is shown on the screen. This shows a series of dams going up the main stem of the Fraser as well as the dams on the tributaries. There is the McGregor and the Thompson rivers and the Clearwater. There is the Quesnel and Cariboo.

The board recognized the importance of the Fraser river salmon runs to the economy of British Columbia and the serious delays which would result to flood protection measures if they had to await a solution of the fishery problem. It examined therefore the possibilities of achieving flood control in conjunction with a partial power system based on those dams which were loacted on river reaches where they would be least objectionable to the fisheries interests. Four stipulations were adopted as follows:

(1) To provide flood control to non damaging levels in the lower Fraser valley.

(2) To form an integral part of a comprehensive plan for the basin in which all the economical power sites would be fully developed.

(3) To be compatible with maintaining anadromous fish runs.

(4) To be economically self-supporting through power production.

One partial system, system "A," which would fulfil all four stipulations was developed as indicated on the screen. This partial system involves a total of five dams on the Clearwater river, three on the Cariboo river, one on the McGregor river, one on the main stem of the Fraser river, at Olsson creek, above Prince George, and one, a low dam, at the outlet of Stuart lake.

The only dam which was considered to offer a problem to the fishery interests was the one at the outlet of Stuart lake, where there are salmon

spawning beds in Stuart lake, but the dam there was only 22 feet high, and an alternative was developed where by raising the dykes in the lower valley Stuart lake could be eliminated from the picture.

System "A" would support a firm peak demand of 1000 m.w. Its total capital cost would be $521,624,000, and the annual cost would be $41,730,000 compared with a power benefit of $41,569,000. The benefit cost ratio based on power benefits alone is therefore 0.99 or slightly less than unity. However, addition of the flood control and other benefits make the system economic.

In extending the life of the board in 1959 the two governments accepted the board's recommendation to establish the physical feasibility of the projects in System "A" and an active program of foundation drilling and mapping is under way.

I have added a few slides here, slides of general interest.

This one shows the forest reserves in the basin. This colour shows from zero to 3,000 cubic feet per acre; the whiter areas are from 3,000 to 6,000 cubic feet per acre; the very dark areas are over 6,000 cubic feet per acre. This colour through here indicates other forest lands. I am afraid I cannot distinguish between those two. The absolutely white areas on there are non-forest land.

The next slide is a picture of the site of the Moran dam, on which there has been simply imposed an artificial Moran dam. It shows the type of chasm in which that site is located. It also indicates the very deep incision the Fraser river cuts through the interior plateau.

Next slide. This is another view of the site of the Moran dam.

The next slide. That is a view taken down near the water surface of the Moran site.

The next slide. That is another view, close to the water. I think that is the last slide.

Mr. Chairman, that is the presentation of the outline of the work of the Fraser river board, which I thought might be of interest to the committee this morning; and I am sure the committee may wish to ask questions.

The CHAIRMAN: I am sure there will be a few questions. Would any of the members care to ask questions on this of Mr. Patterson?

Mr. PAYNE: I have a number, Mr. Chairman.

The CHAIRMAN: You might as well start it off.

Mr. PAYNE: Mine cover a fairly wide field. Mr. Patterson, in the earlier remarks you made, you were mentioning the lack of rain gauge stations, particularly at levels of altitude which are basic to 70 per cent of the basin, or more. What is being done in this connection? Is there a need for these stations, to further your studies?

Mr. PATTERSON: There is certainly need for these stations, but in hydrological studies you run across that situation of never having enough basic data, either of hydrometric records or of meteorological records. We have to accept that situation and do the best we can with the data that are available.

Mr. PAYNE: Is the deficiency such that your information is entirely too scanty to be reliable?

Mr. PATTERSON: No, I would not go so far as to say that it is too scanty for the information to be reliable, but the range of reality has to be wider where your data are limited.

Mr. PAYNE: Is the lack of meteorological rain gauge stations going to delay the work of your board in compiling the necessary studies and reports, or is it not?

Mr. PATTERSON: No, sir. We have a deadline to produce our report, and it is not going to be possible to get the meteorological coverage that one might

wish to have in the period that we have to prepare the report. I am of the opinion that without that data we can produce a report which is satisfactory.

Mr. PAYNE: In other words, this deficiency is not a serious impediment to your work at all?

Mr. PATTERSON: I would say the lack of meteorological data will be a greater impediment after projects are put in place and have to be operated.

You have to have the water out of those reservoirs which you build in ample time to take care of the new supplies of snow melt and rainfall that will come each year.

At the same time, you do not want to get rid of the water in an uneconomic fashion, but you want to make the best possible use of it, when passing it out of the dam, both for power purposes and for irrigation, and all the water uses one might utilize it for.

Mr. PAYNE: In addition to this, surveys would be of assistance?

Mr. PATTERSON: It would be of very great assistance, particularly to the time when you come to operating the structures which may be recommended.

Mr. PAYNE: You were mentioning the upper reaches. Is there a case further up the river basin where the lack is more critical at this time than on the lower regions of the river?

Mr. PATTERSON: For the operation of the structure, certainly the upper reaches are the ones most seriously lacking in information.

One can understand, with the population that exists in the areas closer to Vancouver, that observers are easier to obtain, and stations have been set up there over the years. But when it comes to setting up stations in the high altitudes of the upper reaches of the river basin, it is so difficult to get people to take care of those stations and take off the records.

Mr. PAYNE: I do not want to prevent other members asking questions, Mr. Chairman.

The CHAIRMAN: Do you have a question, Mr. Hicks?

Mr. HICKS: Who is the representative for the federal fisheries department on the board?

Mr. PATTERSON: Mr. Whitmore.

Mr. HICKS: Dr. Whitmore of Vancouver?

Mr. PATTERSON: Yes.

Mr. HICKS: Is he satisfied that if Plan "A" were put into effect the entire fish problem would be protected to his satisfaction?

Mr. PATTERSON: No, I would not say that he is satisfied. At the time we put in that report none of us was entirely satisfied, and that is one of the reasons for the recommendation for further studies, and one of the reasons why we recommended the provisions of monies to investigate the fish runs up in the areas of those proposed dams.

The fisheries department are very active on the job now, and will be until 1963, in getting information at the various dams and reaches of the river which this Scheme "A" would control or change.

Mr. HICKS: You feel, then, that the report which will be coming out will have enough representation from the fisheries department to protect the fish industry, so it will not be hurt by any recommendation this board makes?

Mr. PATTERSON: I am quite confident the representative of the Department of Fisheries will see to it he is not associated with a recommendation he considered would affect the fishery industry adversely.

From my own standpoint, I recognize the value of the fishing industry to British Columbia, and I do not wish to be associated with any report that would damage so important an industry.

Mr. HICKS: Dr. Whitmore is retiring, is he not?

Mr. PATTERSON: Yes, this summer, I believe.

Mr. HICKS: His successor will be equally interested, we hope.

Mr. PATTERSON: Yes, we have had associated with us several of his people on work groups, and they are all very keen and are looking after the fishery interest very well.

Mr. HICKS: As far as the Moran dam is concerned, that is completely "out" from a fishermen's standpoint, is it not?

Mr. PATTERSON: There is no known way, at the moment, of efficiently getting the fish over any structure of that height. I have not heard any of the fishery people that expressed kindly thoughts towards the Moran dam, under the present knowledge of passing fish by high dams.

Mr. HICKS: Is my understanding about the Clearwater correct, when I believe there is no damage whatever to the fish industry caused by installing the Clearwater dam?

Mr. PATTERSON: That is one of the things that the fishery people are investigating, the upper reaches of the Clearwater. There is every evidence there would be no damage from the dams in the upper reaches of the Clearwater. But how far they do get up the Clearwater has yet to be ascertained. In any event, it is a very small run that gets into even the lower reaches of that river.

Mr. HICKS: What ideas have you about the Fraser river dams—at least, the river bank protection, the dykes. Do you think they can be built high enough to protect against that flood danger now existing in the lower Fraser valley?

Mr. PATTERSON: The presence of dykes, I would suggest, is always a threat, in this type of river valley. Erosion and over-topping may occur, and once that happens it is dangerous, and out it goes.

Mr. HICKS: It digs out underneath, and lets them fall out too rapidly?

Mr. PATTERSON: Yes, erosion is a very serious matter in a river valley like the Fraser.

Mr. HICKS: It so happens I gave a talk on this very subject in the House on April 8, and I was very interested in all the evidence you have given. I think it is wonderful to have you come and give this talk to us here.

Incidentally, a few of the things I said are reported in the local papers of the Fraser valley—such as the Abbotsford *Matsqui Sumas News*, the *Fraser Valley Record* and the Chilliwack paper; and a lot is taken from the reports you have reported on this morning. That is all, Mr. Patterson.

Mr. PAYNE: Mr. Chairman, if this is in order, might I follow the sequence of the talk that was given? I would like to ask one or two questions regarding the fishing matter. If I may, could I take them in sequence?

The CHAIRMAN: Yes, Mr. Payne.

Mr. PAYNE: In your earlier remarks, Mr. Patterson, you mentioned the Nechako diversion.

Mr. PATTERSON: Yes.

Mr. PAYNE: What effect has that on the potential flood danger in the Fraser basin itself?

Mr. PATTERSON: 4 per cent at Hope.

Mr. PAYNE: That is in the ultimate, but not now?

Mr. PATTERSON: 4 per cent on the designed flood which was somewhat higher than the 1948 flood.

Mr. PAYNE: You would reduce the flood crest by 4 per cent against your theoretical record of flood level?

Mr. PATTERSON: Yes.

Mr. PAYNE: Is that at the maximum development of the Kemano power project at this time?

Mr. PATTERSON: That is the maximum diversion of that area, above the Kenny dam.

Mr. PAYNE: Through the two tunnels, or the one?

Mr. PATTERSON: Through the two tunnels.

Mr. PAYNE: At the current moment it is what—2 per cent of the maximum flood crest?

Mr. PATTERSON: Yes, 2 per cent of the maximum flood crest.

Mr. PAYNE: And greater if the crest is less than your theoretical maximum?

Mr. PATTERSON: Yes.

Mr. PAYNE: You mentioned very briefly the effect of run-off through habitation and logging operations. Has your board undertaken extensive study in this matter?

Mr. PATTERSON: As a board we did not make any specific studies. We did examine the literature on the subject.

Mr. PAYNE: Which literature?

Mr. PATTERSON: We referred in our report to a study which was made down in the United States, in a basin which was somewhat similar to the Fraser basin. I do not know whether I can put my finger on it.

Mr. PAYNE: Which basin would that be?

Mr. PATTERSON: I do not recall the basin. I wonder if I could get the detail for you?

Mr. PAYNE: Yes. I do not know whether the other committee members would go along with this request, but I would appreciate it myself—and I think the other members would, particularly those not from our area—if at the same time you could bring us a few more details regarding the characteristics—the flow, the depth—of the Fraser. I feel some of our committee members who are not familiar with the basin would perhaps find it better if they had a little of this data and comparables with other river flows and depths elsewhere in Canada. Could that be done?

Mr. PATTERSON: Yes, sir. I think it might be of interest to the committee, in that connection, if I might just make the comparison with the St. Lawrence river as it is flowing down at the Barnhardt power plant at the present time. 256,000 c.f.s. are passing the power plant. We are talking here of a designed flood of 600,000. In the 1948 flood that was only slightly less than that, 536,000, something in that order. So that gives some idea of the size of the Fraser river when it is in flood; and this is at Hope. That is over twice the St. Lawrence down at Cornwall.

Mr. PAYNE: Could you give us some other of the physical characteristics —the depth at flood, the depth at normal mean average, in summer?

Mr. PATTERSON: The depths—if it is the depth of water in the river that you want, that is rather a difficult point, because it varies all the way along.

Mr. PAYNE: I appreciate that, but perhaps you could give it at three or four cardinal points, inclusive of the areas you were discussing in your System "A"?

Mr. PATTERSON: Possibly it is the rise you would like to have?

Mr. Payne: Yes.

Mr. Patterson: Yes.

Mr. Payne: Regarding your decision of your power studies, you indicated that 5,051 megawatts were the total potential, if it was developed fully as a power source, without consideration being given to other factors.

I have trouble following all this terminology in megawatts and kilowatts. We often have horsepower thrown at us too. What is it in terms of horsepower?

Mr. Patterson: 5,000 megawatts is 5,000,000 kilowatts, and if you multiply that by four-thirds it is about 7,000,000 horsepower.

Mr. Payne: Your total potential on the St. Lawrence river is what—developed and potential?

Mr. Patterson: Between 5 million and 6 million on the main stem, in terms of horsepower.

Mr. Payne: Is this a greater potential on full development than the St. Lawrence?

Mr. Patterson: I am speaking of the main stem of the St. Lawrence, while the figures on the Fraser include a number of tributaries. If you add in the tributaries such as the Ottawa and the St. Maurice rivers and other rivers of the St. Lawrence, it would probably total greater than the Fraser.

Mr. Payne: Getting down to the salmon question, that is a matter which has been debated widely in our province, and we hear a most confused set of statistics in connection with the potential effect of certain of their flood control projects in system A.

It seems that everybody who has any specific interest in the Fraser, magically comes up with sets of statistics of his own.

Has your department at any time reviewed the economics of the fisheries as affected by any of these proposed developments? That is, as to the primary loss, the number of fish in terms of dollars and cents which would be lost through the development of any one of your projects in system A?

Mr. Patterson: Well, system A is located well up in the headwaters and, as I indicated, the Stewart lake dam is the one that mostly affects the fishing grounds; and the Stewart lake dam is only 22 feet high.

The fisheries department did not have sufficient information to arrive at an estimate of the damage which that particular dam might do to the fish which spawn in that area; so that for the period to 1963 it is designed to cover in advance what information we had, and it takes in practically a full cycle of the life of salmon.

The fisheries department are obtaining additional data in this area with which a fairly close figure can be obtained as to the damage, or as to what the damage might be.

Mr. Payne: Were the Department of Fisheries studies very, very elementary or, shall we say, non-existent so far as your studies are concerned?

Mr. Patterson: No, I would not say that. I think from the upper areas where they had never been threatened with development that the fisheries people were undoubtedly looking after the lower runs, where the large runs were, and they had never gotten down to minute details.

Mr. Payne: But they are interested in these studies now?

Mr. Patterson: Very much so.

Mr. Payne: And you anticipate that they will come up with answers prior to your next report?

Mr. Patterson: Yes sir.

Mr. Payne: The other question is: what role has been played in these studies by the international north Pacific fisheries commission, and are the Americans contributing in any way to studies that are being undertaken by the fisheries department?

Mr. Patterson: Only through the fisheries department; there is no one in the international Pacific salmon board on our board, nor do they send anyone to our meetings or discussions. They work through the Department of Fisheries.

Mr. Payne: These studies that have been begun in the area of Stewart lake have been undertaken not by your board but by the Department of Fisheries?

Mr. Patterson: We have assigned that to the Department of Fisheries who have qualified people to make the studies.

Mr. Payne: The cost of it is being borne by the Department of Fisheries?

Mr. Patterson: Not entirely; we provided funds last year to hire a biologist to make studies in that particular area, and we provided funds for transportation and helicopters to get into that area and to make these studies.

Mr. Payne: These questions are not loaded in any way; they are definitely searching for information. I may as well be frank and say it astonishes me that when the American salmon industry is dependent on the Fraser to a very large degree—with the Fraser certainly being a great provincial asset under the north Pacific fisheries commission—and when the Americans entered into a committment to follow up and to assist in the study of these matters, it is very difficult to find out where in the world they are contributing in any substance at all?

They are benefiting from the protection of the fisheries and of the fish run on the Fraser, but there has been no indication that they have been acting with us on a partnership basis or carrying their load. You may wish to discuss that matter.

Mr. Patterson: As I said, they are not involved in the Fraser river board studies, except in so far as they may contribute through the Department of Fisheries. But to answer your question personally, I am not qualified. The Department of Fisheries officials I believe would be able to answer the question as to how and where the Americans are contributing to this international Pacific salmon work, under the treaty.

Mr. Payne: It has been indicated that there would be power of 1,000 megawatts. Would you transfer that into horsepower figures?

Mr. Patterson: That again is 1 million kilowatts, or about 1¼ million horsepower.

Mr. Payne: So it is just about 1¼ million horsepower?

Mr. Patterson: Yes.

Mr. Payne: And this could be arrived at for a cost of $521 million, I believe you said?

Mr. Patterson: Yes, I believe that is so.

Mr. Payne: You arrived at an annual cost of $42 million. I do not quite follow that. Do you say that if these units and systems are established, the cost would be $42 million without return from the power?

Mr. Patterson: No; the total annual cost for your financing and your operations and maintenance of power houses and the dams involved—some 11 dams, I believe—would be that $42 million annually.

Mr. Payne: With returns from the power?

Mr. PATTERSON: And your returns from the power would be approximately the same figure, $42 million.

Mr. PAYNE: So if you take the power of the proposed development of the system from the net cost, it is offset by the power production?

Mr. PATTERSON: Yes, that is right.

Mr. PAYNE: But if you do not have the power production, I take it that the annual outlay is $42 million without recovery?

Mr. PATTERSON: Not quite that. If you do not have power involved, you would not have to equip power plants, and your cost would not be as high.

Mr. PAYNE: What would it be?

Mr. PATTERSON: Under scheme A particularly to the lower sites of the Clearwater, which are strictly power sites, and would be added to the scheme in order to improve the economics—

Mr. PAYNE: And to be used for storage?

Mr. PATTERSON: To use the storage upstream and to improve the economic return to the province—

Mr. PAYNE: What would system A be if its job did not involve hydro at all, but only flood protection and water storage. What would the cost of system A run to, in its total aggregate, and in its annual service exclusive of any power development?

Mr. PATTERSON: Well, you would eliminate two of the dams entirely; you would eliminate the power installation, as well at five others; several of them are strictly storgae dams in any event; several of them are for storage and for power, on-site power; and two of them are strictly power dams which were thrown in to get a return which would make it economic.

Mr. PAYNE: Excluding this, and taking it entirely from the point of view of the established dams for flood control, what would the aggregate cost be, exclusive of these hydro units? What would be both the aggregate basis and the annual charges?

Mr. PATTERSON: I do not have those figures available.

Mr. PAYNE: Would they be available for another day?

Mr. PATTERSON: It could be drawn out of the data which the board has developed.

Mr. PAYNE: We could have that brought to the committee?

Mr. PATTERSON: It would be expensive flood control.

Mr. PAYNE: We are striving here for facts and comparisons in order to try to build up a true picture. One of the problems we have in British Columbia is that every time salmon is touched, the economy of the province has gone flat on its face.

I would like to bring this out and to make the point that we would like to have facts and figures. That is our desire for this information.

Mr. PATTERSON: Yes sir, we will get those figures for you.

Mr. PAYNE: Thank you.

Mr. DUMAS: You said that the total estimate of power that could be developed on the Fraser is roughly seven million horsepower?

Mr. PATTERSON: That is correct, sir, and that is not complete development; that is a major portion of the development that is possible. There are some tributaries, and certain limited areas on which we did not have data at the time we made our report.

Mr. DUMAS: What percentage has been developed up to date?

Mr. PATTERSON: You mean on the Fraser alone?

Mr. DUMAS: On the Fraser.

Mr. PATTERSON: There is an installation of about 1,600,000 I think, in the Fraser river basin. But you cannot compare an installation to the power figures because the power houses are always over-installed; there is always spare equipment put in the power houses, and that may run something like 20 to 25 per cent.

The way they are building power houses, the percentage is often much higher, because they install these power houses now for peaking purposes, and they take care of flood flows as they go, and use the power to replace thermal installations and the use of coal and oil.

Mr. DUMAS: Does that include the diversion of power to the northwest, there?

Mr. PATTERSON: No sir.

Mr. DUMAS: I understand the total development in the Canadian section of the St. Lawrence is roughly 14 million horsepower.

Mr. PATTERSON: Well, at Barnhart or Cornwall there are 2,200,000.

Mr. DUMAS: The whole basin of the St. Lawrence including the St. Maurice and the Saguenay is what? 13.6 million horsepower were installed in the St. Lawrence river basin, the Canadian section, and I think they estimated there was another 8 million possible.

Mr. PATTERSON: That would include the Canadian installation at Niagara, too.

Mr. DUMAS: So probably the St. Lawrence river basin has three times the possibility of the St. Lawrence river?

Mr. PATTERSON: If you include all the north shore tributaries of the St. Lawrence it might run well over three times.

Mr. DUMAS: How far up the Fraser do the salmon go?

Mr. PATTERSON: They have indications that they go well up beyond Prince George.

Mr. DUMAS: The proposed construction of the Moran dam would create a problem for the fishermen.

Mr. PATTERSON: That is right.

Mr. DUMAS: That is the biggest dam?

Mr. PATTERSON: The Moran dam stands out because it is a spectacular engineering proposition. It is a very large and high dam; but it is not the only one that develops the head in that section of the river. It may be done in smaller steps.

Mr. DUMAS: If the Moran dam was built south, perhaps it would be possible to let the fish go up the river?

Mr. PATTERSON: Well, from the information that I have been able to gather it is that the mortality of the delay with a structure of that size would be very serious; and whether they can devise elevators to lift them over—and even when they do that, they have a problem of getting the fingerlings down, and when they come down through the turbines many of them are damaged by the pressure which is there. They are damaged by the high pressure which they have to experience, when they are thrown out and the pressure is released.

Mr. PAYNE: Does your system A envisage the Moran dam?

Mr. PATTERSON: No; there is nothing in that route of river development in system A; but system A could be an integral part of a future over-all plan.

Mr. PAYNE: The system we are discussing does not include a proposal to develop the Moran dam?

Mr. PATTERSON: No sir; there is nothing in the main stream of the Fraser river below Prince George.

The CHAIRMAN: Well, gentlemen, we have had a very exhaustive discussion about the work of the Fraser river board; and I am sure that Mr. Patterson will prepare the information that Mr. Payne asked for. I shall arrange to submit it to the committee. I do not think it will be necessary for Mr. Patterson to appear again.

Mr. PAYNE: I do not like to make requests which would put any official out, certainly not Mr. Patterson; but I would like it if he would appear again and discuss, briefly at least, some of the side benefits such as land reclamation, what irrigation is possible along the Fraser, and its potential value. I understood you have made certain studies in that connection for the board?

Mr. PATTERSON: Well, the board's studies with respect to additional irrigation are very limited indeed. We have indicated that many of these reservoirs will provide the ability to get water to benches when it does not now appear economic to pump water to them.

Mr. PAYNE: Is that phase covered in your terms of reference?

Mr. PATTERSON: No, it would depend on how broadly you interpreted the terms of references. And in the time we had available we did not interpret it very broadly. We endeavoured to confine our studies to the two main items, which were flood control and power, and the way in which any of these projects might affect existing resources.

Mr. PAYNE: In your earlier testimony you indicated a rather extensive familiarity with parts of the Cariboo, and that they were very lacking in water resources and participation having regard to Fraser river development and control. You are not in a position to give us information as to the several benefits which would accrue in this way?

Mr. PATTERSON: Not the Cariboo itself, or do you refer to the whole interior plateau?

Mr. PAYNE: Basically the whole basin; in other words, downstream benefits which would accrue from the accumulation of storage. This we know is a consideration relevant to discussions and negotiations in connection with the Columbia. Has this subject been left out of our studies entirely on the Fraser?

Mr. PATTERSON: Not entirely, sir. Of course we were not involved in the matter of distribution of downstream benefits, and the power of the Fraser. We did determine power at particular sites but we didn't endeavour to distribute it to the upstream storage which created it.

The CHAIRMAN: Mr. Payne, if you wish we shall endeavour to arrange for Mr. Patterson to come back at a future date. But we have a schedule laid out here now, and we will have to try to fit it in.

I have circularized the members of the committee outlining for the next two weeks the witnesses we can expect; and you will receive that circular in your mail today.

Next Monday we shall have Mr. Menzies, of the Department of National Health and Welfare, and Dr. Berry, general manager and chief engineer of the Ontario Water Resources Commission. Quite a few members of the committee are interested in this polution problem.

There will be one change from the circular which has already gone out in the mail to you. We are going to endeavour to have the St. John river board on May 17. They are in the schedule you will be getting, where it is shown that Mr. J. S. Bates, chairman of the New Brunswick water authority will undoubtedly also be with us; but we are endeavouring to fit that in with the St. John river board study.

Mr. DUMAS: Do you have people coming from Quebec with respect to this problem?

The CHAIRMAN: Yes, we have also invited Mr. Prevost. I do not know whether it has been confirmed yet; but he could not come at the time we first invited him; however he will be coming at a later date.

Mr. DUMAS: Thank you.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 9

MONDAY, MAY 9, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESSES:

Mr. J. R. Menzies, Chief, Public Health Engineering Division, Department of National Health and Welfare; and Dr. A. E. Berry, General Manager, Ontario Water Resources Commission, Toronto.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23048-2—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.,

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, May 9, 1960.
(10)

The Standing Committee on Mines, Forests and Waters met at 11.00 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Baskin, Doucett, Dumas, Fleming (*Okanagan-Revelstoke*), Granger, Hicks, Kindt, MacRae, Martel, Martin (*Timmins*), McQuillan, Murphy, Payne, Robichaud, Simpson, Slogan and Stearns—(18).

*In attendance:* Mr. J. R. Menzies, Chief, Public Health Engineering Division, Department of National Health and Welfare; and Dr. A. E. Berry, General Manager, Ontario Water Resources Commission, Toronto. *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; J. D. McLeod, Chief Engineer, Water Resources Branch, and K. Kristjanson, Secretary, Advisory Committee on Water Use Policy.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Messrs. Menzies and Berry to the Committee and then called on Mr. Menzies.

Mr. Menzies made an extensive statement on water pollution in Canada and was questioned thereon.

The Chairman then introduced Dr. Berry to the Committee.

*Agreed,*—That a brief prepared by Dr. Berry on the Water Pollution Problem in Ontario be taken as read and included in this day's evidence.

Dr. Berry amplified the brief mentioned above, copies of which were distributed to members of the Committee, and was questioned thereon.

*Agreed,*—That a document submitted by Mr. Murphy, a member of the Committee, and prepared by Dr. Ayers, of the University of Michigan, Ann Arbour, Michigan, entitled "The probable effects of a gusher oil-well in the alongshore water of Lake Huron" be printed as an appendix to this day's evidence. (*See Appendix "A"*).

At 1.10 p.m., the Committee adjourned until 9.30 a.m. Tuesday, May 10.

M. Slack,
*Clerk of the Committee.*



23048-2—1½

# EVIDENCE

MONDAY, May 9, 1960.
11:00 a.m.

The CHAIRMAN: Gentlemen, we have a quorum; I call the meeting to order. We have with us today Mr. J. R. Menzies, chief of the public health engineering division of the Department of National Health and Welfare. Mr. Menzies will present a brief to us. Unfortunately, we have not enough copies to distribute to all the members.

We also have with us Dr. A. E. Berry, general manager and chief engineer of the Ontario water resources commission.

Mr. Menzies will present his brief first. Mr. Menzies, would you please come up to the table.

Mr. MURPHY: Mr. Chairman, before you call on Mr. Menzies I would like to say that I appreciate, on behalf at least of the Ontario members, and I think everyone, the presence here this morning of Dr. Berry from Toronto, who has been very, very active in his determination—both pleasant and persistent—to exercise some well meant advice on municipalities and persons in connection with the serious pollution problem.

Dr. Berry, incidentally, Mr. Chairman, is not only recognized in Ontario as an authority, but throughout North America, and I am very glad that we have him here.

The CHAIRMAN: Thank you, Mr. Murphy. Would you proceed, Mr. Menzies, please.

Mr. J. R. MENZIES (*Chief of public health engineering services, Department of National Health and Welfare*): Mr. Chairman: May I first of all thank the committee for this opportunity to appear before it to discuss the important matter of water pollution from coast to coast.

This subject has many aspects which with few exceptions, need to be considered in relation to local conditions. Wastes from industries and municipalities are intimately associated with pollution problems, usually in combination but sometimes separately. Remote areas may have troubles caused by pollution but these are usually of lesser importance than those encountered in sections of the country which are heavily populated and highly industrialized. The overall effects of pollution are usually considered in relation to further use. Another important factor is the assimilative capacity of the receiving waters, a property which varies from time to time, being dependent on many things such as volume, seasonal fluctuations and reaeration characteristics.

Of the many uses of water, some are much more seriously affected by pollution than are others. Those of greatest importance with respect to physical, chemical and bacteriological quality are municipal and industrial supplies. Pollution affects recreational and agricultural uses to a lesser degree, while power development and navigation are adversely affected to a very limited extent, if at all.

Water carriage of wastes has become almost standard practice and other methods of disposal are seldom possible. As the rate of population growth and industrial development accelerates in our country, the need for water will increase even more rapidly. The per capita requirements within the home

have risen rapidly in recent years. The volume of wastes will go up concurrently, as will pollution, unless effective treatment is provided. The efficient use of available supplies will demand attention, particularly in those areas where supplies are limited. Repeated use of the same water is already practiced widely on this continent and will become more common, thus placing greater importance on the efficient treatment of wastes and water supplies.

The problems of pollution abatement and control are complex. In only a limited number of cases does the contributor of pollution gain direct benefits from waste treatment. This may occur when the recovery of raw materials or the production of by-products from the wastes compensates in whole or in part for the expenditures required to control pollution. Communities and industries which use as a source of water supply or recreation the waters into which their wastes are poured also benefit from remedial measures. Another compensation for providing waste treatment is frequently found in improved public relations. Such benefits can be reasonably effective with or without legal restrictions. In a majority of cases, only the downstream user of the polluted water receives substantial relief when waste treatment is provided. This emphasizes the need for a coordinated and effective program of control based on regulations which provide the necessary authority. Because waste treatment methods are only partially effective it is not normally possible to restore water to its original state of purity. Underground disposal of wastes is sometimes practiced but this procedure is usually feasible only for rather limited quantities of wastes.

The ownership of resources, including water, and the control of municipal affairs is largely vested in the province concerned. Therefore the degree of control exercised by provincial departments of health, control agencies and commissions is reflected in programs of pollution abatement. Consequently the results vary a great deal. Local conditions frequently make corrective action imperative and this is reflected in the present status of pollution control throughout the country.

The federal government also has certain responsibilities in regard to pollution. International relations, inland and sea fisheries, navigation, and a concurrent authority in the case of agriculture, are assigned to the federal government under the British North America Act. By virtue of section 92(10) of that act, the federal government may also legislate on works which are declared to be for the general advantage of two or more provinces.

On the basis of existing legislation the federal government has very limited control of pollution, particularly in respect to human wastes. The Boundary Waters Treaty of 1909 is of major significance in relation to international problems. When water pollution reaches objectionable proportions the International Joint Commission may be called upon to investigate conditions and recommend remedial action. The correction of transboundary pollution reverts to the states and provinces in which it originates and efforts by them to promote improvements receive the active support of the commission.

Other federal legislation which has a bearing on pollution control exists.

There is the Navigable Waters Protection Act which places restrictions on the discharge of materials of certain kinds into navigable waters or waters flowing into navigable waters. Its purpose is to protect the interests of navigation and it is concerned chiefly with those types of wastes which would tend to obstruct channels and streams.

The Fisheries Act is similar in character and places restrictions on the discharge of materials deleterious to fish life.

The Migratory Birds Convention Act prohibits the deposit or discharge of "oil, oil wastes or deleterious substances—in any water frequented by migratory wildfowl, or that flows into such water, nor on ice over either of such waters."

The Department of National Health and Welfare Act states that the Minister of National Health and Welfare shall enforce "any rules or regulations made by the International Joint Commission, promulgated pursuant to the treaty—so far as they relate to health." The treaty referred to is the Boundary Waters Treaty of 1909, previously mentioned.

The Criminal Code of Canada defines a common nuisance as "an unlawful act or omission to discharge a legal duty, which act endangers lives, safety, health, property or comfort of the public, or by which the public are obstructed in the exercise or enjoyment of any right common to all Her Majesty's subjects". This has not been accepted in the past as a useful means of effecting pollution control. It is difficult to prove the exact cause and locate the source of a common nuisance when several wastes are involved.

The Department of Transport has "General and Special Regulations for the Government of Public Harbours in Canada" which place restrictions on the discharge of various wastes, rubbish and oil. The National Harbours Board regulations are similar. These regulations are based on the Canada Shipping Act.

Similarly, Oil Pollution Prevention Regulations, under authority of the Canada Shipping Act, were promulgated in March, 1957.

While this legislation is reasonably effective for the purposes for which it was intended, it has limited value in the overall control of municipal and industrial wastes.

Because of its responsibilities in matters related to health, and the intimate relationship between pollution and water-borne disease, the Department of National Health and Welfare has always been concerned with the problem of waste disposal on federal property. While the act creating the department does not confer any specific authority in this field beyond that already quoted, a program of co-operation with other departments of the federal government has been developed. The results have been worthwhile since most large sources of pollution originating on federal property lying outside urban communities have been effectively treated or plans for treatment are well advanced. Most departments of the federal government, and crown corporations, are playing an important role in this general policy of pollution control.

I would now like to quickly review the pollution problem across the nation on the basis of drainage basins. The following information is based on a preliminary study which I prepared some months ago. As it has not yet been reviewed by the field officers of my department who are more familiar with the regional scene, there may be some minor inaccuracies in it.

*Drainage Basins*

The mainland of Canada can be divided into four main drainage basins—the Pacific, Arctic, Hudson bay and Atlantic. There is a small area in southern Alberta and Saskatchewan which lies in the gulf of Mexico drainage basin.

*Pacific Basin* (400,730 sq. mi.)

The most important rivers in this basin are the Columbia, Fraser and Yukon with several smaller rivers between the Fraser and Yukon watersheds. Heavy concentrations of population are, with few exceptions, on or near the sea. Consequently the rivers in this basin are relatively free of pollution with the exception of the lower reaches of the Fraser. A few inland communities are served by sewage treatment plants but very little has been done to date to treat sewage from coastal communities. Similarly industries are concentrated in the vicinity of the sea. Wastes have seriously affected recreational use in

some areas such as greater Vancouver, where a primary sewage treatment plant is being constructed, and at Victoria. Some of the wastes are significant in respect to fish and shellfish. Bacterial pollution from domestic sewage is affecting the use of sea water in plants which process fish and some areas have been closed to shellfish production as a measure of protection for the consumer.

Pollution in inland streams is always a problem in respect to water-borne traffic since water may be used for drinking and culinary purposes by persons not fully acquainted with potential hazards (e.g. natives).

*Arctic Drainage Basin* (1,380,895 sq. mi.)

The most important river in this basin is the Mackenzie. Some domestic sewage and a little industrial waste enter this river system. The population on the watershed of this river is very small and the larger centres have been provided with sewage treatment, for example, Inuvik, Yellowknife and Fort Smith. Every effort is being made to control smaller sources of pollution, this being under federal control in the Northwest Territories.

There is little or no significant pollution in the other major rivers—the Anderson, Coppermine and Back.

*Hudson Bay Drainage Basin* (1,421,350 sq. mi.)

A large number of rivers are located in this basin, the most important being the Nelson and Moose. The main tributary of the Nelson is the Saskatchewan river which drains a large part of the developed areas in Alberta and Saskatchewan. The low flows in the Saskatchewan river appear to present a real problem so far as future development of those provinces are concerned. The North Saskatchewan river below Edmonton has been affected by the discharge of municipal and industrial wastes in the past but remedial measures have been employed to correct the most objectionable conditions by treatment of some municipal and industrial wastes although important sources of pollution are still without treatment facilities. Storage facilities on the upper reaches of the North Saskatchewan river will make it possible to increase minimum flows and thus improve conditions. This should also provide for increased population and industrial development. Municipal and industrial wastes are treated at Edmonton. Municipal wastes are treated at North Battleford but not at Battleford or Prince Albert.

Conditions in the South Saskatchewan river have not been as severe as in the North Saskatchewan. Industrial wastes in the Calgary area have been responsible for imparting objectionable tastes to fish for some distances downstream from that city. Municipal wastes are treated at Calgary, Lethbridge and Swift Current, located on tributary streams, but not at Medicine Hat and Saskatoon on the main stream.

The Red river drains into lake Winnipeg and thence to the Nelson river. Most of the wastes entering the Red river in Canada receive some treatment, for example, Greater Winnipeg provides primary treatment. The Assiniboine river, a tributary of the Red river, with its principal tributary the Qu'Appelle river, drains a large area of Manitoba and Saskatchewan. Municipal wastes are treated at Regina, Fort Qu'Appelle, Virden, and Portage la Prairie. Brandon, one of the larger cities on the watershed, has not provided treatment for its sewage.

Another major river in this basin is the Moose. Some communities and industries are located on its tributary streams. Kapuskasing, Cochrane and Timmins, the principal urban communities on this watershed, all have sewage treatment plants. Industrial wastes, principally from paper mills, receive little treatment, but this is not too important at present as the flow to the north is largely through wilderness country. Sewage treatment is provided for federal installations at Moose Factory, near the mouth of Moose river.

Most of the other rivers drain uninhabited or very sparsely settled areas.

*Atlantic Drainage Basin* (580,097 sq. mi.)

The importance of this basin is self-evident. On the watershed of the St. Lawrence river and its tributaries are located over one-half of the country's population and probably eighty (80) per cent or more of the nation's industries. More than two-thirds of the urban population served by sewage treatment in Canada are residents of Ontario. There is comparatively little sewage and waste treatment elsewhere in the basin although an increasing interest in the problem of water pollution, particularly in New Brunswick, suggests that greater emphasis will be placed on pollution abatement soon. Quebec has indicated a renewed interest in the quality of its surface waters.

As on the Pacific coast most urban communities in New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland, are found on or near salt water. Wastes from those communities and from some industries have had detrimental effects on the use of the receiving waters. This has been most obvious in relation to shellfish production in the Maritimes but fresh fish processing has been affected, also recreation. With respect to the latter there are still numerous safe bathing beaches which are remote from serious sources of pollution.

Within the scope of this review it is hardly possible to discuss individual areas within the basin, so I shall confine the discussion to major areas.

The Great Lakes have areas of pollution in the vicinity of the towns and cities on their shores, the extent of the polluted area usually being directly related to the size of the community. Similarly rivers carrying pollution cause substantial areas of pollution where they discharge into the lakes. The rivers connecting the Great Lakes are all polluted to varying degrees. These rivers, Lake St. Clair and small areas of the large lakes near the inlets and outlets of the rivers were studied in detail in 1946-49 by the International Joint Commission. Substantial and continuing improvement has been achieved in these waters in the ensuing years through treatment of municipal and industrial wastes. Further improvements will be required to bring them all into compliance with "objectives for boundary waters quality control". The St. Lawrence river has not been studied in detail as yet. However it is known to be grossly polluted in some sections. Many of the streams which empty into the Great Lakes and St. Lawrence river are comparatively small in volume. Where their watersheds have been largely denuded of forest growth many of them carry very little water in the summer months.

Pollution in the Ottawa river varies widely since its watershed includes large forested as well as highly developed areas. Gross pollution extends from Hull and Ottawa to its junction with the St. Lawrence river due to municipal and industrial wastes, the latter originating to a large extent in pulp and paper plants.

Tributary streams in the province of Quebec receive substantial volumes of municipal and industrial wastes in the developed portions of the province while most of those on the north shore of the estuary and gulf are still without pollution or are relatively clean. The Saguenay river would be an exception but detailed knowledge of its conditions is lacking. The Richelieu river rises in the United States but wastes originating there are purified in lake Champlain. Some other rivers entering the St. Lawrence river from the south are known to receive substantial volumes of wastes.

There are a number of ways whereby pollution abatement could be encouraged and made more effective.

(1) There is a basic need for a more accurate knowledge of conditions in our surface waters. The information obtained by detailed studies would be invaluable in planning for increased demands for water in the future and for the control of sources of pollution. Any major increase in the number and scope of river and lake studies would necessitate a corresponding enlargement

of staff and equipment. The agencies now responsible for pollution control would seem to be best qualified to undertake such studies but most of them appear to be understaffed at present.

(2) Similarly action taken to regulate seasonal fluctuations in run-off could be helpful since the most objectionable conditions develop during periods of minimum flow. Power development and water conservation projects have had beneficial effects on some watersheds. Associated with this is the need for better control of land use. Reforestation, for example, tends to increase minimum flows.

(3) Better knowledge of pollution and its effects must be disseminated. The uninformed taxpayer will not provide the public funds which are required for waste treatment.

(4) Research can assist in the development of new and better measures to combat industrial and municipal pollution. New products alter the character of wastes. Satisfactory and economical methods for the treatment of many pollutants are not known. Provinces, municipalities, industries and federal agencies either separately or acting on a cooperative basis could provide direction, encouragement and financial assistance essential to effective research. Facilities for the development of better waste treatment and pollution abatement measures are presently very limited in Canada.

If I might interject, Mr. Chairman, I think Dr. Berry will be telling you something different about the situation in Ontario. However, that is a statement which, I think, is correct, so far as the whole country is concerned.

(5) The collection and dissemination of knowledge concerning new developments and problems by qualified experts could contribute greatly to the success of control programs now in progress as well as to all research projects.

(7) Dissemination and exchange of information collected by the various groups concerned should be arranged so that the benefit of new techniques or approaches may be as widespread as possible.

These are some of the things which might be done. Some of them would be costly, others less so. I have neglected the questions of by whom these things ought to be done and the extent of federal participation. These aspects would seem matters more properly to be considered by this committee. In the past however the federal government has cooperated with the provinces in such fields as wild life, geological surveys, forest inventories, and various aspects of water, such as recording of surface waters, ground waters, sedimentation and meteorological records. Possibly therefore it could formulate a similar program for the investigation of water polluation.

The CHAIRMAN: Thank you very much, Mr. Menzies.

I am sure that some of the members will have questions to ask at this time.

Mr. MURPHY: As a layman, and an expert in this field, would you agree that water is our most important asset?

Mr. MENZIES: It would be very difficult, indeed, to think of anything that is more valuable. I think that would be a reasonable statement.

Mr. MURPHY: Is not that the consensus of a lot of people?

You mentioned in your brief that the pollution menace is not the great problem facing governments on all levels—and you mentioned the necessity of educating the public to the extent of this problem.

Mr. MENZIES: As I pointed out in the brief, I think education is one important facet of the whole thing.

Mr. MURPHY: Well, people have to become fully conscious of the situation, do they not?

Mr. MENZIES: Yes, that is true. Unless they are, they do not provide the funds.

Mr. MURPHY: And unless they are told about this pollution menace, which is becoming greater, the problem is not going to be solved.

Of course, you indicated the different governmental spheres—federal, provincial and municipal; and there is also the field of the international joint commission, which comes under international jurisdiction. Has there been in the past, or now, the necessary cooperation and coordination between these three levels of government, in order to seek a solution to this pollution problem—or, is it in the discussion stage?

Mr. MENZIES: I would think, sir, that in some areas there has been excellent cooperation and, possibly, not so much in others.

Mr. MURPHY: We want you to be very frank, Mr. Menzies, because the only way this committee can come up with recommendations is for the witnesses to tell us what they think. We do not care whom you offend. That does not make any difference to us.

For instance, you mentioned that the Navigable Waters Protection Act, the Fisheries Act, the Migratory Birds Convention Act, the Department of National Health and Welfare Act, and so on, upon recommendations of the I.J.C., can initiate regulations, or enforce regulations.

Mr. MENZIES: No. The I.J.C. has no authority at the present time to regulate or enforce regulations in the field of water pollution. It does have authority in other fields. However, in regard to water pollution, no authority was granted it under the boundary waters treaty, to have regulations controlling pollution.

Mr. MURPHY: Do they have any jurisdiction over lake Michigan?

Mr. MENZIES: There has always been a great deal of controversy about that.

Mr. MURPHY: But the act does not give them that jurisdiction, does it?

Mr. MENZIES: That has been the approach that has generally been taken in the past.

Mr. MURPHY: We will let the act speak for itself. It does not give the I.J.C. any power over lake Michigan, which is not a boundary water.

Just along that same line—and I think this happened last fall—some ship had disposed of a certain amount of oil in one of the British Columbia ports—and I think it was Vancouver, or some other place—and I believe they were fined $500, or something like that; and only recently we had a similar occurrence in Sarnia harbour. I understand the penalty is only $500.

Could you tell me how many convictions were registered under the act in the last two, three, or even five years?

Mr. MENZIES: I am sorry, but I cannot answer your question. This concerns another department of government.

Mr. MURPHY: I wonder if we could get that information—that is, the number of convictions that have been registered?

The CHAIRMAN: We will attempt to get that information for you.

Mr. MURPHY: I would like the number of convictions for that particular offence. They could obtain it from the Department of Transport. I think we should have it on the record.

Mr. MENZIES: You probably also would want to get information from the wildlife services under the Department of Northern Affairs and National Resources.

Mr. MURPHY: Will you tell the committee the difference between a sewage treatment plant and a sewage disposal plant?

Mr. MENZIES: The terms usually are used synonymously. It depends on the person using them.

Mr. MURPHY: Let us say that a municipality has been asked to put in a sewage plant. I consider it a sewage disposal plant. However, I think I am wrong in that. Is there such a thing as a sewage disposal plant in Canada?

Mr. MENZIES: As I said, when people speak of sewage treatment, they usually use the two terms.

Mr. MURPHY: Supposing it goes through that plant, regardless of whether it is one treatment or the other, what is the product, after the treatment?

Mr. MENZIES: That depends entirely on the degree of treatment that is used, the method of treatment, and the extent to which it is carried out.

Mr. MURPHY: Are there any plants in Canada—and I am referring to sewage disposal plants—which treat the sewage so that there is no harm to the water in the lakes or rivers, as the case may be, into which it flows.

Mr. MENZIES: I pointed out in my brief, sir, that at the present time there are no perfect treatment plants. In other words, you can treat the sewage to the best possible advantage, and there will still be some pollution remaining.

Mr. MURPHY: You mean, a great deal of pollution remaining?

Mr. MENZIES: It may vary widely, depending on the degree of treatment. Even with the best treatment there is still a residual of pollution exists. The only exception to that would be if you had a treatment process which did not have an effluent.

This has occurred in some of the prairie provinces, with the sewage lagoons or the waste stabilization ponds, where the filtration into the soil, plus evaporation, balance the total amount of sewage treated. There you have a perfect set-up and, consequently, have no further pollution. But that is rarely possible.

Mr. MURPHY: Do you know, what they have in Chicago, Mr. Menzies?

Mr. MENZIES: They have quite a variety of treatments there. Most of them are capable of reducing pollution by roughly 75 or 80 per cent. There is an activated sludge process in most cases.

Mr. MURPHY: We have not anything like that in Canada?

Mr. MENZIES: Yes.

Mr. MURPHY: Where abouts?

Mr. MENZIES: There are quite a few activated sludge plants in Canada. Edmonton is a good example in the west; and there are Stratford and many smaller communities. I think Dr. Berry could give you a better picture of that in Ontario than I can. Many of the federal installations are complete treatment. There are not too many in the activated sludge field, but Camp Gagetown has a complete treatment plant and the activated sludge method of disposal.

Mr. MURPHY: Is there much difference in the cost?

Mr. MENZIES: The cost will vary widely from community to community. You cannot very easily give it.

Mr. MURPHY: Well, will it be twice as much?

Mr. MENZIES: I would want to know what you are comparing it to, before I could even guess at it.

Mr. MURPHY: Then I will confine those questions to Dr. Berry.

There is another question I would like to ask before I conclude for the time being. You mentioned the St. Lawrence basin?

Mr. MENZIES: The Atlantic basin.

Mr. MURPHY: Did that include the Atlantic provinces?

Mr. MENZIES: Yes.

Mr. MURPHY: Part of Quebec?

Mr. MENZIES: Yes.

Mr. MURPHY: Did that include the Great Lakes and Ontario as well?

Mr. MENZIES: Yes.

Mr. MURPHY: What percentage of the large cities in that area have treatment plants; or do they all just empty into the water, into the lakes or rivers?

Mr. MENZIES: As I indicated, most of the municipal treatment is in Ontario; and possibly Dr. Berry could give you an idea of that. There is very little treatment in Quebec.

Mr. MURPHY: What about Montreal, with all due apologies to my friends from Quebec?

Mr. MENZIES: There is no treatment at Montreal; and there is no treatment in any large city in the province of Quebec.

Mr. MURPHY: It just goes as raw sewage into the river St. Lawrence?

Mr. MENZIES: Yes, quite.

Mr. MACRAE: I just want to ask Mr. Menzies to confirm something I understand.

In the northern United States, the Monongahela river at Pittsburgh, a few years ago, was declared a dead river, because it was said that every form of living organism had been destroyed because of human waste, pollution and the water was unfit for any use whatsoever. I do not know whether that is true or not, but has any Canadian river come even close to that state yet?

Mr. MENZIES: There have been small portions of some rivers which have become devoid of oxygen, which is getting pretty close to the condition you are talking about.

Mr. MACRAE: Is that true of the Monongahela river, which would support no form of fish life, or anything like that?

Mr. MENZIES: I am not familiar with that river, but I suspect it could well be so.

Mr. MACRAE: You mentioned the plant at Camp Gagetown, just a few moments ago, and I am familiar with it. It is supposed to be a very efficient and fine one.

To your knowledge, is that the general plan now of government installation everywhere: They do try to put in a sewage disposal plant so the rivers will not be polluted, if there are many personnel involved?

Mr. MENZIES: We have had excellent cooperation, for many years, with the Department of National Defence in that respect; and, in fact, with all departments of government.

As I have indicated to you, our department does not have any direct authority under the act; but this cooperative program has been built up over the years, whereby we are usually asked for advice as to the type and degree of treatment to be used. Consequently across Canada, with very few exceptions, waste from federal installations is being treated.

The exception to that—and we were caught up on this this past winter—was where the federal property is within an urban community. There is no sewage treatment provided if that community does not provide it.

Mr. MacRae: Thank you, Mr. Chairman.

Mr. Dumas: Mr. Menzies, could you tell the committee how much money is being spent by the federal government for the abatement and control of pollution in Canada?

Mr. Menzies: It would vary a very great deal from year to year, depending on the number and types of installation that are being made. To the best of my knowledge, no one has ever undertaken to compile that data.

Mr. Dumas: Would you say we could spend more money on the abatement and control of pollution?

Mr. Menzies: I think everything possible is being done as quickly as possible. There may be delays of two or three years in some cases, and possibly longer in others, when the funds are not there for construction.

Mr. Dumas: You would not have any information on the amount of money being spent by the provinces for the same purpose?

Mr. Menzies: No, I do not know that data has been collected either.

Mr. Dumas: What about the industries? Do you feel the industries across the country are co-operating and are trying to control their waste and to treat the waste from, let us say, pulp mills?

Mr. Menzies: I would say that that question has to be answered this way: right from the best of co-operation to the worst, depending on the location and the amount of pressure that has been brought to bear. But industry, in my opinion, has only recently taken a very active part in pollution control.

Mr. Dumas: Do you think they are taking a very active part now?

Mr. Menzies: Some industries are now; others are not.

Mr. Dumas: I understand we will be able to have more information from Dr. Berry, especially concerning Ontario; and next week, Mr. Chairman, I understand Quebec will be represented at the hearing of this committee?

The Chairman: Well, the witnesses invited from Quebec are not going to be able to come next week.

Mr. Dumas: But they will come?

The Chairman: We have asked them to come.

Mr. Murphy: Mr. Menzies,—

The Chairman: Mr. Murphy, there are about four or five other members who have been waiting to ask questions.

Mr. Murphy: Go ahead.

Mr. Slogan: Mr. Menzies, you mentioned treatment plants, and that Winnipeg had a primary treatment plant. Could you differentiate between the different types of treatment?

Mr. Menzies: Generally speaking, primary treatment plant involves the settling of sewage—that is, the readily settleable portion of solids. These are taken out of the collection tanks and, in the case of Winnipeg, are disposed of into storage lagoons where the digestion is completed, and eventually the sludge is removed. Broadly speaking, this will reduce the amount of pollution in the sewage by about 30 to 40 per cent. In other words, there are some solids which are still carried over, and dissolved material in the sewage; and this is discharged into the Red river.

Mr. Slogan: Is the bacterial count lower in the water?

Mr. MENZIES: There is some reduction, but it is not a very significant factor. Very often, in association with primary treatment, they also use chlorination, which substantially reduces the bacteria.

Mr. SLOGAN: Who sets the regulations regarding the amount of sewage that can be dumped into a river—for instance, in the Red river, which is a navigable river?

Mr. MENZIES: Basically, that is a provincial field of jurisdiction.

Mr. KINDT: I should like to ask Mr. Menzies a question on the magnitude of pollution. I have heard it said that a city of 250,000 inhabitants, dumping raw sewage into a river, creates pollution downstream equivalent to 25 dead horses passing a given point per hour. Do you agree?

Mr. MENZIES: It is a most unusual approach to the subject. Unless the horses were decaying at a very great rate, I do not think there is any comparison at all. I think they would float by and cause very little trouble.

Mr. MARTIN (*Timmins*): In reading your brief I noticed that you mentioned the fact that controls vary, province by province. Also, further in the brief, I gathered that the control within the province varies from place to place. Does that mean that this variation is because some municipalities are more pollution conscious than others? Is there any province which has sort of a standard which it attempts to enforce throughout the province?

Mr. MENZIES: I would say, sir, that most provinces have regulations, but as I indicated in the brief, local conditions have a very direct bearing on the need for pollution abatement. I do not like to use comparisons, but I might mention that Saskatoon has no treatment. I have spoken to the provincial people there and they say they realize that the river downstream from Saskatoon is polluted, but the use of that river for a long distance down is so limited that the pollution does not have any serious consequence. Therefore, you have to judge these things on a local condition basis, and future use. I am not sure whether or not I have answered all your questions.

Mr. MARTIN (*Timmins*): There was one other thing which has to do with the endeavours of the federal government to enforce its regulations. I am asking this because there are quite a number of different branches. You mentioned that the lack of pollution control in one area may not be anywhere near as serious as a similar lack of control in another area. Does the federal government attempt to apply sort of a uniform enforcement of its regulations across the country?

Mr. MENZIES: To the extent that the various departments have regulations, I would say yes, so far as I am aware; but as I also indicated, the federal government has very little control over pollution, particularly municipal and industrial pollution.

Mr. MARTIN (*Timmins*): I have one further question. In your opinion would it be better if the various departments which are handling this now were coordinated. Do you think it could be handled better if they were coordinated? Would it be possible to have one department looking after this problem now, since it appears that three or four government departments have attempted to apply their remedies to certain factors. In other words could the upstream methods be improved?

Mr. MENZIES: I would think as a quick answer, yes it surely could be possible to coordinate all this. There are, however, many acts and many different regulations. It would be a major undertaking.

Mr. MARTIN (*Timmins*): What I have in mind is, when these acts were passed the pollution problem certainly was not as serious as it is today. With the increasing problem, do you think it would be very beneficial to have

attention paid to this matter with a view to assessing the situation in its present light, rather than in the light when these various acts were passed.

Mr. MENZIES: Well, a review of that kind certainly would be useful. I do not know whether or not it would add greatly to the efficiency of the application. In other words each department has specialists on its staff who consider the application of these things. I would suspect what you would wind up with would be a hodge-podge sort of a department with all types of persons in it perhaps not closely related in their knowledge or responsibilities.

Mr. MURPHY: Following up on Mr. Martin's question, Mr. Menzies, this is the article I was going to refer to a moment ago. It is by Mr. Arve Dahl, an authority who I think is recognized at least by Dr. Berry. Mr. Dahl gave this paper in Chicago last December at the sixth annual conference of the American association for the advancement of science respecting pollution. He had this to say:

> For more than 40 years no fundamentally new sewage treatment processes have been developed. Although many refinements in the art have been made and the effectiveness and capacity of treatment increased, the fundamental principles have remained the same.

He goes on to say:

> If we cannot treat wastes sufficiently to avoid nuisance conditions under our best, most modern practices today, how shall we meet the water needs of future generations? I believe that one of our great research challenges is the development of practical—and perhaps novel—methods of attaining higher degrees of waste purification.

Do you agree with that, Mr. Menzies?

Mr. MENZIES: Yes, I do.

Mr. MURPHY: Do you know of any research done in connection with this project? What about the one some time ago about some plan of absolute disposal of sewage?

Mr. MENZIES: Are you referring to the atomized suspension technique?

Mr. MURPHY: Well, I read in the papers about this in the last few months. Is there anything to that?

Mr. MENZIES: It is a method which has been used in the installation at Beaconsfield to dispose of sewage sludge which is quite different from the disposal of sewage itself. It is disposal of the solid material which is collected from sewage.

Mr. MURPHY: It does not go in the streams or lakes.

Mr. MENZIES: No. The resulting powder is buried or otherwise disposed of. It is quite inoffensive.

Mr. MURPHY: Have you any knowledge of any research done in any field federally or provincially over the last 10 or 15 years?

Mr. MENZIES: There has not been a great deal. Some of the provinces have done research with the assistance of federal health grants, but these usually are related to small installations.

Mr. MURPHY: This is an alarming statement. It seems to me we have not come to grips with the problem.

The CHAIRMAN: Mr. Menzies, do you not have the benefit of a great deal of research and experience in respect of the installation of other plants where they have sewage disposal problems in the United States and in other parts of the world.

Mr. MENZIES: Absolutely. This reference Mr. Murphy made is to a paper presented by a representative of the public health service, and they have a huge research establishment at Cincinnati, Ohio.

Mr. MURPHY: I know.

Mr. MENZIES: There they are attacking all phases of the pollution problem very actively. The only thing at the present time in Canada which is comparable to it is the research laboratory under Dr. Berry's organization which is starting up, and I will let him talk about that.

Mr. MURPHY: I presume Dr. Berry also will speak only for Ontario.

Mr. MENZIES: Yes.

Mr. MURPHY: You do not have any idea how much was spent by any province for research?

Mr. MENZIES: There is very little indeed. There are very few facilities anywhere, outside of this new laboratory in Ontario, which are capable of doing research.

Mr. MURPHY: I believe there was a statement made here by someone about a river in the United States in which the water is not fit for drinking or bathing and is prohibited for use in any way. According to this article there are 16 good sized rivers in the United States which are not fit for drinking water, bathing, or even for industrial use. Do you agree with that?

Mr. MENZIES: I have no count in respect of the situation in the United States. I do know that last week in Lafayette, Indiana, there was reference made to the repeated use of river waters; and in fact in one case the only water one community had was the sewage discharged from the next community upstream. That is getting pretty serious and is in fact beyond being serious; it is pitiful.

Mr. SIMPSON: Have any studies been made, and if so what would you say were the results of findings in relation to the varying degrees of pollution by natural causes in the United States? Suppose you have an industrial plant in an area which is not too heavily populated disposing of its wastes into a water flow, how far downstream would that normally go before there was any marked degree of lessening of the pollution? Have there been any studies made on that?

Mr. MENZIES: Yes. Again, the answer would have to be that it varies a great deal, depending on the character of the waste.

We had a case in the western provinces some years ago where the waste was found downstream 500 miles, and possibly it went a great deal further.

Mr. SIMPSON: I was thinking of, say, the Nelson river drainage. In the southern part of the province we have the Red river coming in there to Assiniboia, waste from the city of Winnipeg and other rivers, and the Saskatchewan river flowing into Lake Winnipeg and a certain amount of waste coming in.

Would there be tests, say, at the Nelson river to determine the extent of the pollution at that stage of the drainage, or is there great importance attached to natural causes?

Mr. MENZIES: I think it would be almost impossible to find any trace of pollution in the Nelson river because of the huge lakes the water has passed through in between. That is one of the finest natural purifications that there can be. When you have a large, quiescent body of water, wastes are confined more or less to a localized area. I would think that the Nelson river would be as clean as you could probably find anywhere.

Mr. KINDT: Along the same line as Mr. Simpson's question, Mr. Chairman: There is a prevalent feeling in the west that where a stream becomes polluted

by natural causes—say, a number of cattle in the fields, or something of that sort—downstream for a reasonable distance, a mile, two miles, three miles, of a fast-flowing stream, the water, by natural methods, becomes relatively pure.

Can you throw any additional light on that statement?

Mr. MENZIES: First of all, I would say there is still some difference of opinion about the seriousness of natural pollution. That is, not too many animals carry bacteria which will cause sickness in man.

The statement that this kind of pollution is purified in a mile or two is, of course, quite inaccurate. The purification is based more on a time interval than a distance interval. That is, if you have, let us say, bacteria which may be harmful to man, the faster the water flows, the further they can go before they become extinct; and consequently the danger is increased proportionately.

If you have other kinds of pollution, such as the one I referred to in north Saskatchewan, again, the faster the water flow, the more people may be affected by it.

So the answer varies from one type of pollution to another, from the use that is made of the water. But this remark that you made to start with was very popular 20 or 30 years ago. In fact, people thought that once pollution went through rapids they had nothing to worry about, which is quite inaccurate.

Mr. AIKEN: Mr. Chairman, might I ask one further question on this subject? How is purification accomplished in water?

Mr. MENZIES: It is a very complex action, actually. There is settlement of solids, and then they decay on the bottom. It is actually the effects, largely, of oxygen which reacts with the pollutants to bring them down, or stabilize them, you might say. All the purification methods that man has devised are simply methods of speeding up this process.

Mr. MARTEL: Mr. Menzies, you mention in your brief that paper mills' waste affects the waters of different rivers and, in fact, was responsible for the pollution of waters in the Ottawa river and secondary areas, if I understood correctly.

Would the waters in the Ottawa river also be affected by the radioactive wastes of the Chalk river plant?

Mr. MENZIES: There has been a very close and accurate control maintained over that, and I read just a couple of weeks ago that up to the present time they have not detected any evidence from the plant, even at Pembroke, Ontario, which is quite close to the actual plant.

Mr. MARTEL: They have some installation to protect the waters from radioactive materials?

Mr. MENZIES: They have excellent methods of controlling all the radioactive materials.

Mr. STEARNS: With the powers that the federal government possesses, have they ever taken action? Has the federal government ever taken action against a municipality or an industry for pollution of waters, that you know of?

Mr. MENZIES: I would have to relate that to existing legislation, let us say the Migratory Birds Convention Act, which prohibits the killing of migratory fowl by oil.

Mr. STEARNS: I was not referring to that; I was referring to sewage or liquids coming from chemicals and from pulp and paper mills.

Mr. MENZIES: I would say that in that case the federal government does not have authority to take action.

Mr. STEARNS: It has no authority. That is what I wanted to find out.

The CHAIRMAN: But, Mr. Menzies, there are prosecutions from time to time under the Fisheries Act, are there not?

Mr. MENZIES: Oh, yes.

Mr. MURPHY: Mr. Menzies, how long have you been with the department—quite a while?

Mr. MENZIES: Thirty-one years.

Mr. MURPHY: That is good. Do you know if any action has been taken by your department at the suggestion or request of the international joint commission?

Mr. MENZIES: As I indicated to you, while that is written into our act, the commission does not have, initially, the power to promulgate regulations—which is a curious situation, actually. The act gives our department authority to do something, but it does not give the other entity authority to initiate what our department is authorized to do.

What actually develops out of that is that when pollution references are made to the international joint commission, they look to our department for people to put on their advisory boards and conduct such activities as may be related to that reference.

Mr. MURPHY: Mr. Chairman, I think this committee should study the Navigable Waters Protection Act, because it is in that act that I believe prosecutions are laid against ship owners for emptying their sewage and oil into, say, harbours.

I suggest that because I do not think that is a deterrent, and I imagine our experts here will agree with that. I am going to suggest that perhaps we could have some opinions respecting the necessity of these ships being provided with equipment to take care of these discharges, instead of their emptying them into harbours—because they can go to a port and have the facilities of the sewage disposal system to empty their garbage and oil.

I have known of only two or three prosecutions, and sometimes it is hard to detect. But they would rather pay the fine than give up the habit of throwing all this waste into harbours and lakes. We in Ontario are vitally concerned, on the Great Lakes, and I noticed a protest the other day from Montreal. I think in the last year there was only one prosecution.

I hope we can be given information about the number of prosecutions, and I think we should study that part of the act.

The CHAIRMAN: Thank you, Mr. Murphy. Mr. Simpson.

Mr. SIMPSON: I would like to bring up a question, Mr. Chairman, that is possibly of provincial jurisdiction. I think it is something on which this committee should probably be informed. That is, could we find out just what jurisdiction the provinces have? Perhaps they all have different legislation on it; but, generally, could we find out what jurisdiction the provinces have in regard to pollution of navigable waters or rivers?

The CHAIRMAN: Perhaps Dr. Berry can enlighten us on that when he presents his brief, because he is working under a provincial department.

Mr. KINDT: Mr. Chairman, I have just one other question I would like to ask Mr. Menzies. The subject of individual education has been brought up, and social action.

I feel, from experience, on this serious pollution problem which we have downstream from many cities, that what the individual can do to prevent pollution is very limited. It is a question of social action.

In other words I can illustrate my point. I was upstream from a large city not very long ago, when I saw a big sign there which said, "please flush the toilet. Somebody in the city down below needs the water." Now, that illustrates my point. My point is that the individual does not have much control over

pollution. It is a social problem. And if we are going to come to grips with this situation, we must do it from the point of view of what action responsible governments should take. Do you agree with that?

Mr. MENZIES: Yes, that is very true. There is nothing that any one entity can do or handle by any means.

The CHAIRMAN: I think that is the whole purpose of having these witnesses appear before us, to give us an an acquaintance with the problem so we may make certain recommendations.

Mr. MURPHY: Perhaps the steering committee might consider having someone come here from the Department of Transport to go over the Navigable Waters Protection Act.

The CHAIRMAN: Yes, we shall endeavour to do that at a future date.

Mr. SLOGAN: Mr. Martel asked a question about waste disposal on the Chalk river a few minutes ago. This concerns a great many people. There is a very adequate system of waste disposal in force there. Five per cent of the total operating costs are allocated toward waste disposal and safety measures.

They have been testing the water there for the last fifteen years and they have not found any strontium 90 in the fish in the Ottawa river. Actually the amount of radioactivity put into the river at Chalk river is less than that which comes into the river through radioactive fallout.

I think these few facts would attest to the safety measures taken on the Chalk river.

The CHAIRMAN: Thank you.

Mr. MARTEL: I wonder if Mr. Menzies could tell the department if he or the Department of National Health and Welfare are being consulted from time to time by the Chalk river authorities in respect to any danger, and do you find any progress being made in the disposition of their wastes?

Mr. MENZIES: A method of disposal of waste was developed at the time the plant was installed and it has been successful to date. So far I know of only one change that has taken place in dealing with radioactive waste in recent years. It is a method of incorporating what they call their hot waste into a glass substance so that it may be disposed of. It would probably be thousands of years before even a small part of it would escape.

Mr. MARTEL: You are being kept posted in respect of these results in the Department of National Health and Welfare?

Mr. MENZIES: We do not get detailed reports from the commission because they have authority to deal with it within the commission itself. This authority was given when this plant was built. However our department does maintain control over radioactive isotopes. We also have data on radioactivity in many industries.

Basically it is the function, within one of the divisions of the Department of National Health and Welfare, to maintain supervision over this. But to the best of my knowledge we do not get detailed reports from the Atomic Energy commission on wastes that may enter the Ottawa river. In fact there is no reason why we should, because there never has been any.

The CHAIRMAN: Gentlemen, Dr. Berry is here from Toronto. We might wish to question Mr. Menzies further, and he could be made available to us in that connection at some future meeting.

Dr. Berry has given us copies of his brief which will be distributed to you at this time. He will not read his brief, but he will make references to it. Might I ask the committee if you wish to have the brief incorporated in the minutes of today's proceedings at this point?

Agreed.

*Note:* Dr. Berry's brief is as follows:

Subject—The Water Pollution Problem in Ontario

This statement is an outline of the extent of water pollution, what is being done to overcome it, the problems associated with this program, and activities and procedures of the Ontario water resources commission.

It is thoroughly recognized that water pollution in Ontario is a matter which must be kept under control at all times. It is imperative for the health and welfare of the people of the province. At the outset some general observations on pollution may be in order.

*Water Use and Pollution*

Water must be recognized as one of the most important natural resources of any country. Without an adequate supply there can be little progress in growth or human betterment. Since the quantity of water in the world always remains constant it is only necessary to consider changes in quality and in its distribution. It must be used over and over again as it journeys from rainfall to the sea. This reuse must become more frequent as populations increase and concentrate in urban centres and as industry expands. The serious deterrent to this maximum beneficial use of water comes from pollution. This can quickly change the water to a damaged, useless resource of little value to anyone until the purifying processes of nature restore its quality. Further pollution added along the route may keep this resource in a continuously deteriorated condition where it cannot serve the many purposes for which it is needed. Accordingly, polluted water is similar to a deficient supply.

*The Nature of Pollution*

The nature of water pollution is continuously changing. So also are the effects produced. Man's health may be endangered by bacterial pollution and by other constituents of the water. But pollution manifests itself in other respects as well. The water is objectionable aesthetically, unsuitable for swimming, unfit for fish and wildlife, unacceptable for boating and other recreational uses, injurious for live stock and agricultural purposes, defective for industrial use, and tending to the deterioration of property values.

Many substances discharged into water can result in pollution. Domestic sewage was the first to be recognized as such, but today this is only one of many sources and not infrequently it is not the dominant one. This is well illustrated in the two surveys of boundary water pollution made by the international joint commission. In the former in 1913, sewage was the all-important factor, but in the 1946-48 survey industrial wastes had reached entirely new proportions. Quite different effects on the water were produced.

The current view is that pollution is anything which may impair the quality of the receiving water. It is so stated in The Ontario Water Resources Commission Act. This would include silt or turbidity from gravel washing operations, oil wastes, chemical substances, or wood fibre, none of which contains much bacterial load. Other substances may be high in organic wastes which tend to rob the water of oxygen and create septic and odorous conditions. Taste components may travel long distances and still retain their properties of tainting fish, or creating most offensive conditions in drinking waters.

Industrial wastes have had a marked impact on the water pollution problem in recent years. They are creating difficulties in finding suitable treatment processes. It is reported that there are now over 500,000 distinct chemical compounds in use in industrial production whereas 20 years ago there were only a few hundred. Of equal significance is the statement that over 10,000 new compounds are being developed each year in laboratories and that it is estimated 400 to 500 new chemicals are put into use each year. Many, if not most, of

these chemicals in the process of manufacturing, result in waste products, the drainage from which must enter some body of water for final disposal. Examples of these chemicals are pesticides and detergents. It is stated that in the United States more than 600 million pounds of chemical pesticides are used annually and in Canada the estimate is 60 million pounds. Similarly synthetic detergents have increased in use tremendously in recent years. The effects of both of these are likely to be felt in the watercourses of this continent.

The problem of industrial wastes is aggravated by the constantly changing nature of the resulting wastes. Methods for effective treatment may have to be developed after intensive research. The toxic effects of some of these wastes may not be clearly established, or at least the long term effects. Nuclear wastes are another example of changing conditions resulting from the scientific advances of modern times.

It can only be concluded that water pollution is a more complex problem now than at any time in the past. This has been brought about by the major advances in the industrial field with the many different wastes therefrom, and the difficulty of giving effective treatment to these substances before they are added to the stream flow.

*Urban Growth*

Coincident with industrial waste problems must be considered both the increase in population and the concentration of this in urban centres. These changes have been rapid since the war. They mean that more wastes must be discharged and the effect of dilution is lessened. If these increases are accompanied, as they are in many instances, with ever-lower stream flows in the summer months the pollution effects are all the more significant.

*Legislation in Ontario*

In Ontario the legislation applying to pollution control is The Ontario Water Resources Commission Act passed in 1957 and with certain amendments made since. This authorizes the appointment of a commission of three to seven members. The commission is given wide jurisdiction over the water resources of the province. Much of the authority of the Public Health Act in this field was transferred to this commission.

In brief, the functions of the commission may be stated as follows:

(1) to exercise supervision over all water supplies, water works, sewage works, industrial wastes, and all related matters

(2) to construct and operate, under agreements with municipalities, water and sewage works.

This latter procedure is a new one for meeting the problems of this field. It has now been in effect for a long enough period to assess the accomplishments and expectations. It is especially applicable for pollution control. The legislation also provides penalties for the discharge of any material into any stream or watercourse which may impair the quality of that water. The provision against stream pollution is thus quite definite. Marked progress is now being made in carrying out a province-wide control system.

The procedure followed by the commission in undertaking water or sewage projects is to conclude an agreement with the municipality. The commission then undertakes the engineering, construction, financing and operation of the necessary works. The money is supplied by the province at actual cost, and the debt may be retired over a long period of about 30 years. In all of these projects there is close co-operation between the commission and the municipality. In some cases several municipalities are involved in the one project, with the cost being allocated according to the service rendered.

*Boundary Waters*

The boundary waters between Canada and the United States have been the subject of two references to the international joint commission. These investigations have revealed the sources of pollution and the effects these may have on the other country. There is close co-operation between the international joint commission and the Ontario water resources commission in this work. The investigation of 1946-48 was followed by a program of continuing surveillance of these waters by the international joint commission, and the advisory boards report to the commission semi-annually on progress in pollution abatement.

*The OWRC Program*

The members of the commission are:

Chairman—A. M. Snider

Members—W. D. Conklin, C. S. MacNaughton, R. M. Simpson, J. A. Vance and A. A. Wishart

The program of the OWRC has now been under way for three years. Gratifying progress can be recorded. In the construction of works the commission now has agreements for 117 projects for an expenditure of $48,776,489. It is interesting to note that 54 of these are for sewage works at a cost of $34,263,607 and 63 projects for water at an expenditure of $14,512,882. The number is increasing steadily, at present there are 27 water and 25 sewage for a total of 52 projects now in operation. Several more will be completed in the next few months. Sewage works programs in the province had been delayed, but under this new plan these are proceeding rapidly and the expenditures are much higher than for water works. Most of the larger centres of population are now proceeding with their sewage treatment programs.

Encouragement given to the installation of water and sewage works in Ontario is reflected in the certificates of approval issued in 1959 for municipal projects amounting to 1975 certificates for an estimated expenditure of $115,726,003. The fact that over $73 million of this expenditure was for sewage works shows the emphasis on this and the part that it will play in pollution control.

In addition to the construction of works the commission has an extensive program directed to pollution control in all waters. Some of these measures may be of interest:

(1) Water quality objectives have been adopted for all waters in the province.

(2) Water pollution surveys are being carried on as rapidly as staff permits. They yield valuable information on which to base activities against this pollution. The number of these surveys completed in 1959 exceeded 150, and nearly 4000 samples were collected in this work.

(3) New methods of sewage treatment are studied in an effort to provide the most effective results at the lowest costs.

(4) The industrial waste program is being intensively carried out to ensure results at the same time as for domestic sewage.

(5) A new and modern laboratory and research station has just been put into service to aid the commission in its assistance to municipalities. Over 75,000 analyses a year will be made here.

(6) The staff of the commission is giving assistance to municipalities in the solution of technical problems. It is planned to hold sessions in the new laboratory for the training of plant operators, and for others engaged in these activities.

(7) Examination and study of stream flows in an effort to use them to best advantage in the control of pollution.

*The Industrial Waste Situation*

Industrial wastes call for special consideration in any pollution program. These wastes are increasing in volume and variety as the province grows and becomes more industrialized. Many of these are accepted into the municipal sewers, while others are discharged through private outfalls. The importance of industrial wastes was recognized by the commission at the outset, and its program was designed accordingly.

Some of the troublesome industrial wastes come from pulp and paper plants, mill plants, packing plants, canning factories, metal plating industries, tanneries, oil refineries, chemical industries and others. Some are produced in great volume, some have far-reaching effects and may travel long distances in a stream, some are toxic, and all will adversely affect the receiving waters if not given adequate treatment first. Research facilities are important to meet the problems created by industrial wastes.

There is need for close co-operation between industry and the water resources commission in solving the pollution problem. Encouragement is given for industries of the same kind to work together and to pool their information on waste disposal. There has been splendid co-operation on the part of industry in Ontario and this can lead to effective results even though some of the problems are particularly complex.

*Status of Sewage Works*

Some figures on the status of sewage works and particularly treatment facilities are pertinent to an analysis of the pollution problem.

| | |
|---|---|
| Number of sewerage systems | — 246 |
| Population served | — $3,755,000 or $64,870 of the population of the province. |
| Number of sewage treatment plants | — 263 |
| Number of secondary sewage treatment plants | — 110 |

A substantial number of urban communities do not have sanitary sewerage systems as yet. The number with population in excess of 500 is 117. Many of these have storm drains, and there is a tendency for sanitary wastes to be connected into these with resultant stream pollution.

The situation throughout the province now is that most urban centres have embarked on sewage treatment programs. These are in various stages of development from early planning to near completion. The Grand river, as an example of a stream in a concentrated area of the province, will soon be receiving thoroughly treated sewage from all municipalities. This, combined with increased summer flow from storage basins, will bring great improvements. Other water courses are being given similar attention. Larger cities and towns situated on major watercourses have until recently delayed their programs and have relied on dilution as the method of disposal. Fortunately these deficiencies are now being corrected. The completion of all municipal sewage treatment works, as well as industrial waste plants, requires a considerable period of time, but the program is now on the way and is expected to be finished without undue delay.

*Pollution in Navigable Waters*

The province of Ontario is fortunate in the number of it slarge streams and lakes. These are assets of untold value. They not only provide water for drinking and sanitary purposes, but because of their size they are important in the field of navigation. The great lakes system is outstanding in this respect. Control of pollution from shipping, pleasure craft, and other activities is not easily solved. Domestic sewage and refuse from boats has not been brought under effective control as yet. Oil wastes may spread over wide areas. Accidental spills of oil or other boat cargoes are difficult to avoid. Similarly these wastes may, as a result of accidents from shore operations cause damage to the waters. If drilling for oil in the great lakes results in accidental or uncontrolled spills the effects on the waters may be great, although few such accidents in these waters have been reported to date. It is a major problem to protect against accidents in shipping and in other uses of these waters. Pleasure craft have increased greatly in recent years and these add further complications in the pollution control program.

*Present Day Problems*

While much progress is being made in pollution abatement in Ontario many problems are encountered. Some of these are listed herewith.

(a) Finances must be considered one of the major problems, especially for municipalities faced with many demands for services, most of which have a greater public appeal than sewage plants. The costs of trunk sewers and treatment works are high. Municipalities are faced with indebtedness which approaches the safe economic limit. This is still a serious problem to many municipalities in spite of all that can be done to offset it.

(b) Public support for sewage treatment costs is difficult to obtain. Lack of sewage treatment seldom has a direct effect on the householder who is concerned chiefly in getting the sewage off the premises and into the sewers.

(c) The rapid growth in population taking place in Ontario adds a further problem in providing sewage treatment facilities to keep pace with this. It is especially so when industrialization concentrates the population in urban communities. More sewage effluent is then discharged to the stream with reduced benefits of dilution.

(d) As has been seen industrial wastes have increased at a rapid rate, and there is no indication that this will not continue. These wastes may have objectionable effects on the waters even in low concentrations. Much is still unknown about the long-term toxic hazards of these wastes either on man or aquatic life. Other effects of a non-toxic nature may also be involved. This is seen in the taste potentials of some of these substances.

(e) Research can provide answers to these difficult industrial wastes as well as other substances reaching streams. The need for extensive research is increasing as the wastes grow in complexity. A co-ordinated research program embracing all groups that can contribute is needed.

(f) The regulation of stream flow to prevent flooding and too rapid runoff, and to conserve water to add to the stream in time of low flow is of great importance in pollution control. Since pollution results from an excess concentration of objectionable substances in the water, dilution is an important ally in the campaign.

(g) A further problem involves newer and less costly sewage and waste treatment facilities. There needs to be continuous efforts in this direction.

*Summary and Conclusions*

The water pollution problem in Ontario is recognized as an extremely important one and for this reason aggressive action is being taken. It is imperative to control it and to safeguard the water resources of the country. As the population grows and stream flow diminishes in summer, these waters must be used over and over again many times before the stream ends its journey to sea or is evaporated. The cost of pollution may be too great for any country to tolerate either in human health or national welfare. The great lakes, the major streams and the small ones all need the protection which will ensure their purity for all general uses.

The program for adequate pollution control will require, among other measures, the following:

(1) Active participation of all levels of government, industry and private persons, with a full realization of the significance of the problem and the need for its solution.

(2) Adequate finances to ensure effective disposal systems to meet the local requirements.

(3) Public support for these programs including the ratepayers, organizations and groups having an interest in the welfare of the country.

(4) Effective enforcement on a co-operative and helpful basis between the enforcing agency and the party faced with the task of waste disposal.

(5) An active research program in which all groups will participate and co-ordinate their efforts; the knowledge and skills of many professional disciplines and specialities—engineers, chemists, biologists, physicians, educators and others are needed to secure scientifically sound answers to many questions.

(6) A program of stream flow regulation to aid waste disposal by dilution and by natural purification.

(7) Close study to reduce costs of waste treatment methods.

(8) Adequate control over industrial wastes which are now being produced or which may occur in the future, with careful examination of these by industry and the province before they are allowed to endanger the water supply.

(9) Sufficient facilities to ensure effective control over pollution and including laboratories, specially trained staff, and finances.

(10) Reasonable legislation, suitable standards for stream quality and co-operation among municipalities and industries where their several interests can best be served by joint action.

Where these measures are included in a full program for pollution control on a province-wide or national scale, there is no reason to feel that the streams and lakes cannot be maintained in a clean and sanitary condition.

Dr. A. E. Berry (*General Manager of the Ontario Water Resources Commission*): Mr. Chairman, and gentlemen: the brief which has just been distributed to you contains information on the extent of water pollution and the problem which exists in Ontario, and with respect to some of the steps which are being taken in this province to deal with it.

I was somewhat in doubt as to what information might be required by the committee, and I hope as we go over it that some of the questions that were asked this morning may be touched upon.

In the first place I think it must be pointed out that water pollution in Ontario is recognized as something which must be kept under control, regardless of anything else.

The water resources commission is very cognizant of the need for pollution abatement. They regard water as one of the most important natural resources in the country. I think it is fair to say that ever increasing emphasis is being placed upon this fact.

One thing I would like to mention, which is quite often overlooked, is the fact that the amount of water in the world remains always the same; and for that reason it is a question of the use made of it.

Now it is sometimes repugnant to some people to think that what was sewage at one time is being used as drinking water later on. Well, there is no other way to do it. The whole problem is one of the adequate treatment of wastes so that we may make the best use of this water as it flows from the point where it drops as rain into the sea.

In some instances it is necessary to use that water over and over again, but there is nothing wrong with that, if these wastes are washed, and if there is adequate protection against pollution.

I have said something in the brief about the nature of pollution. There is a changing concept in recent years in respect to pollution. In the early days when industry was not developed as it is today, the whole danger from pollution was considered to be bacterial contamination. That of course is still a potent factor. But water may be objectionable aesthetically; it may be unsuitable for swimming, or for fish and wild life, and unacceptable for boating and for other recreational uses. It may be injurious for livestock and agricultural purposes, and it may be unsatisfactory for industrial use.

All these conditions may occur in water if no adequate control is placed on it. There are many substances which might cause impairment of the quality of water. It is interesting to observe in the first survey in 1913 and the boundary water reference of the international joint commission that the main factor then was bacterial pollution.

But in 1946-47, the survey to which Mr. Menzies made reference, the situation was entirely changed. Bacterial pollution was still present, but there was the added problem of industrial wastes. So we have to consider the broad aspects of what forms pollution.

On page 3 I say:

> The current view is that pollution is anything which may impair the quality of the receiving water.

Those are the words used in the Ontario Water Resources Commission Act, and I think they sum up the situation quite well. In other words, there might be turbidity or silt from gravel washing operations which would make very little bacterial contamination, but which would impair the quality of the water, and as such it would be regarded as pollution.

Industrial wastes have had a marked impact on the water pollution problem in recent years. They are creating difficulties in finding suitable treatment processes.

There are some figures given on page 3 which I hope may be of assistance to you. It is reported that there are now over 500,000 distinct chemical compounds in use in industrial production, whereas 20 years ago there were only a few hundred. That is a pretty clear indication of the change that is taking place.

Of equal significance is the statement that over 10,000 new compounds are being developed each year in the laboratories; and it is estimated that 400 to 500 new chemicals are put into use each year. It is stated that in the United States more than 600 million pounds of chemical pesticides are used annually. The estimate for Canada, which I have been able to secure, is 60 million pounds a year. Similarly, synthetic detergents have increased tremendously in recent years. The effects of both of these are likely to be felt in the water courses of this continent.

There are many other wastes that have a similar problem in regard to disposal. There are complications in the treatment of these industrial wastes. One of these complications is that we do not have yet, in many instances, adequate treatment for these. Another feature is the fact that these wastes are continually changing. No sooner do you get a method developed for one waste, and it has changed to something else. That is evident, when we see this statement that I just gave, in respect to the chemical compounds that are coming on the market. I think it can only be concluded from this that water pollution is a much more complex problem today than it was in the past. As soon as these substances go on the market, and new ones are developed, we must face that situation of finding proper treatment methods for the disposal of these so that they will not injure the quality of the receiving water.

Mr. Menzies made reference to a waste, having those properties, in the south Saskatchewan river, which was given publicity a number of years ago. It flowed many miles down that stream. I think newspaper reports said it was something between 500 and 800 miles. Now, that is a very serious situation. It is my understanding that at that time there was not a well understood method for treatment of the wastes to offset those characteristics.

Such is the situation in regard to industrial wastes.

I mentioned something on page 4 about urban growth. Since the last war, we not only have the industrial waste problem in intensified form, but we have a much greater growth of population, which is concentrated more in the larger centres. So, the sewage effluent from there must be discharged into that stream. And even if it is well treated we still have some waste going out at the discharge point—and it creates a difficult problem.

I make reference on page 5 to the legislation in Ontario. Just for information purposes, I would like to point out what is being done in the province of Ontario because, in extending this information to me, I assumed you wanted that information.

In Ontario, the legislation applying to pollution control is the Ontario water resources commission act, which was passed in 1957, and to which amendments have been made each year.

In brief, this sets up a commission, the functions of which may be stated as follows: No. 1, to exercise supervision over all water supplies, water works, sewage works, industrial wastes, and all related matters—a pretty broad assignment. No. 2, to construct and operate, under agreements with municipalities, water and sewage works.

The latter one is most unique and, as far as I have been able to ascertain, it is the only place in the world where a program of this nature is in operation. I want to give you some information later on in regard to what has been accomplished under that legislation. However, you can see the two broad assignments—to exercise supervision over these water supplies; and to construct, operate and, of course, finance the water and sewage works under agreements with municiplities.

This provision is aimed definitely at pollution control—one of the methods for pollution control.

The next procedure followed by the water resources commission, in undertaking water and sewage projects, is to conclude the agreement with the

municipality desiring these services, at which time the commission undertakes the engineering, construction, financing and operation of those works. It is a very broad program.

Page 6 makes some reference to boundary waters. As Mr. Menzies also has touched on that, I need only say that I think there is close cooperation between the international joint commission and the Ontario water resources commission, in so far as water boundaries in Ontario are concerned.

The program of the water resources commission might be referred to here briefly, just to show what has been accomplished.

In the first place, the commission consists of six members, with Mr. A. M. Snider of Waterloo, as chairman. Those men are not full-time employees; they are men who are giving a public service in the interest of the province.

The construction program, to which I made reference previously, has been carried on since April 1, 1957—just three years ago. The commission now has agreements for 117 projects, for an expenditure of nearly $49 million. It is interesting to note that 54 of these 117 projects are for sewage works, at a cost of over $34 million. Sixty-three of the projects are for water; but the expenditures there are much lower. That is an indication that we, in Ontario, are attempting to catch up on the backlog of sewage work. It is always a backlog, in comparison with water works. The number of agreements is increasing steadily. At present, there are 27 water and 25 sewage works in operation. A total of 52 of the 117 are in operation. They are operated by the water resources commission. Several more of these will come into operation in the next few months.

In addition to the construction of works by the commission, there is an extensive program directed to pollution control in all waters, and some of the measures that are being taken in that regard may be of interest to you. I am referring now to the statement, at the bottom of page 7.

Water quality objectives have been adopted for all waters in the province. This means that we expect that any pollution which may be introduced into a water course will comply with these objectives.

The second part in this program concerns water pollution surveys. Mr. Menzies made reference to the need for information on this. We concur thoroughly in that. The number of these surveys completed in 1959 exceeded 150, and approximately 4,000 water samples were collected. That involves a great deal of work on the part of the staff. It is a question of proceeding as rapidly as staff and facilities are available.

New methods of sewage treatment are being studied to provide effective results at the lowest costs. We feel every effort should be put into it, so that the cost can be kept to a minimum.

The industrial waste program is receiving intensified consideration. A new and modern laboratory and research station has just been put into service to aid the commission in its assistance to municipalities. That laboratory, which is on highway 401, just west of Toronto, is a very modern building, where it will be possible, not only to carry out these various analyses, but to do research work as well. We expect over 75,000 analyses a year will be made in that station—and that is a tremendous program. The staff of the commission also are giving assistance to municipalities in the solution of their technical problems, because there are a great many of these.

Finally in the program, there is the examination and study of stream flows, in an effort to use them to the best advantage. We feel that anything that can be done to increase the flow of water in a stream helps out a great deal in waste disposal.

I make some reference here to industrial waste, and point out there are a number of these wastes that cause particular trouble. They may be present in large quantities. They may be toxic or they may have other effects. Some

of these come from pulp and paper plants, mill plants, packing plants, canning factories, metal-plating industries, canneries, oil refineries, chemical industries and others.

While a good deal has been accomplished towards the treatment of these wastes they are continually changing, and it is one of the functions of industry, as well as the water resources commission, to find methods that will overcome any pollution there may be.

There is also close cooperation between industry and the water resources commission in the solving of these problems. Industry has set up committees in various places, and they are working closely with the commission in dealing with this.

On page 9 there is reference to the status of sewage works. In Ontario the number of sewerage systems is 246. I merely quote this to show the extent of the problem and what has yet to be done. Population served—there is an error in this, it should be 64.8 per cent of the population of the province.

Mr. Kindt: Is "sewerage systems" there synonymous with "treatment plants"—the question Mr. Murphy raised?

Dr. Berry: No, this is where there are sewers. There is a number of these places where they have sewers but no treatment plants. The sewerage system includes the whole system of sewers, treatment plant, pumping stations, and so on.

I am speaking of population served by sewerage systems—three and three quarter millions, or 64.8 per cent of the population of the province.

We have in operation in Ontario 263 treatment plants, of which 110 are secondary treatment.

I think, from the discussion this morning, it is well to emphasize the difference between what we call "primary" and "secondary" treatment. Primary treatment is usually just the settling out of the solids, which reduces the solids in sewage by about 60 per cent. That does not take out much of the bacterial contamination unless there is disinfection with chlorination.

On the other hand, secondary treatment will remove a high percentage of bacteria, solids and organic substances. So, in Ontario we have 110 of these plants giving secondary treatments.

Mr. Murphy: For further explanation—and I think this is important—in your primary plants, what happens to the solids?

Dr. Berry: The solids are digested and usually disposed of on land.

Mr. Murphy: They are gathered and taken away?

Dr. Berry: Yes, they are gathered.

Mr. Murphy: They do not go through the second process?

Dr. Berry: No.

A substantial number of urban communities do not have sanitary sewerage systems as yet. We have given the figure, at the top of page 10, of the communities of 500 population and over. 500 may be considered as rather small, to put in a sewerage system; but there are 117 of these in Ontario that have not yet built these sanitary sewers. They have said they do not have the finances to do it. Many of these have storm drains, and there is a tendency for sanitary wastes to be connected into these and discharged under those circumstances. It is a very significant problem in Ontario.

The situation throughout the province now is that most urban centres—and this is a very gratifying part of this—have embarked on sewage treatment programs. These are in various stages of development. You will realize that it takes some time to complete the preparation of plans and the construction of sewerage works, particularly these large ones.

The Grand river may be cited as an example of this. You have made reference this morning to what is being done in other places in the United States and here. We have considered the Grand river as an example of a stream in a concentrated area receiving both domestic sewage and industrial waste, to a large extent. Very soon this stream will be receiving only treated waste, both from industry and the municipalities. The commission is building these plants.

As an example of this, the city of Brantford has put into operation—or, at least, the water resources commission has put into operation a new, modern sewage treatment plant, which will give secondary treatment to municipal sewage and industrial waste in that area. Similar action is being taken from one end of the Grand river to the other. That is but one illustration of what is being done.

The completion of all municipal sewage treatment works, as well as industrial waste plants, requires a considerable period of time, but it is gratifying to know that this program is now under way and is expected to be finished without undue delay.

Some reference might be made to navigable waters. You have referred to them in your discussion this morning. I think it is well to emphasize that the province is fortunate in the number of its large streams and lakes. These are assets of untold value. They not only provide the water for drinking and sanitary purposes, but because of their size they are important in the field of navigation. The Great Lakes system is outstanding in this respect; it is the greatest body of fresh water in the world. Control of pollution from shipping, pleasure craft and other activities is not easily solved. Domestic sewage and refuse from boats have not been brought under effective control as yet. Much has been done, but there is a great deal to be carried out. Oil wastes may spread over wide areas. Accidental spills of oil or other boat cargoes are difficult to avoid. Similarly, these wastes may, as a result of accidents from shore operations, cause damage to the waters. If drilling for oil in the Great Lakes results in accidental or uncontrolled spills, the effects on the waters may be great, although few such accidents have been reported to date. There have been some, but the number is not great.

It is a major problem to protect against accidents in shipping and in other uses of the Great Lakes. Pleasure craft have increased greatly in recent years, and this is something that is rather significant. These pleasure craft have increased greatly, and they add further complications in the pollution control program.

I have mentioned next some problems in dealing with pollution. I will just go over this quickly.

The first one is finances. In spite of all efforts that have been made, municipalities do find difficulties in raising money for the treatment of the waste.

The second is public support for sewage treatment—and I was glad to hear the discussion of this, because it is very apparent that there is a great need of convincing the public of the necessity of protecting our water resources against pollution.

Then there is the rapid growth in population that has taken place in recent years in Ontario. It is hard to keep up with treatment facilities.

Then we have said that industrial wastes have greatly increased.

Then there is a reference made to research. This can provide the answers to these different industrial wastes. It can also provide answers to more economic and effective methods of sewage treatment. In the new laboratory we are putting a great deal of emphasis on that—research. I hope there will be close cooperation and coordination with these agencies.

Then comes the regulation of stream flow. The regulation of stream control is something that is of assistance in that.

Then on page 13, to summarize and draw conclusions, again I emphasize that the water pollution problem in Ontario is recognized as an extremely important one, that aggressive action is called for and is being taken. The program for adequate pollution control will require, among other measures, the following:

Active participation of all levels of government—as well as industry and private persons. Private persons have an important part to play in this, not only in preventing waste from their own premises going out, but in recognizing the importance of pollution abatement.

Adequate finances are important, if these municipalities are to do the work they are expected to.

Then, again, there is public support for these programs—effective enforcement on a co-operative and helpful basis between the enforcing agency and the party faced with the task of waste disposal. This enforcement is not merely a police action. There must be a co-operative effort in finding solutions to these very difficult and complex problems in waste disposal. Then in No. 5 I say "An active research program in which all groups will participate and coordinate their efforts." Then 6, a program of stream flow regulation to aid waste disposal by dilution and by natural purification would be helpful.

Then No. 10: "Reasonable legislation, suitable standards for stream quality and cooperation among municipalities and industries where their several interests can be best served by joint action." One of the features of the program in Ontario, I believe, is the joint action among municipalities in the construction of their own and industral waste plants.

As a concludng statement I say that where these measures are included in a full program for pollution control on a province wide or national scale, there is no reason to feel that the streams and lakes cannot be maintained in a clean and sanitary condition. It is a question of putting into effect a program of this nature to make certain the waters are protected.

Mr. MURPHY: I think, in speaking on behalf of the members of this committee, I can say this is a very objective brief and is much appreciated by everybody. I am sure you will not hesitate to say yes or no unqualifiedly.

Dr. BERRY: I will be glad to answer any question I can.

Mr. MURPHY: We are sitting here in Ottawa doctor. Is the commission doing anything about the pollution from Ottawa, Hull and the industries here? Is there a sewage disposal plant in Ottawa?

Dr. BERRY: No, but they are working now on a program which involves the construction of a sewage treatment plant.

Mr. MURPHY: Over all these years they have been dumping their sewage right into the Ottawa river?

Dr. BERRY: Yes, without any treatment.

Mr. MURPHY: And the same thing applies in respect of industry?

Dr. BERRY: Yes.

Mr. MURPHY: And the same thing applies in respect of Hull?

Dr. BERRY: Yes.

Mr. MURPHY: In the beautiful capital of Canada. Doctor, I wish to ask you about this proposed new method of disposal of sewage. Is there anything to it?

Dr. BERRY: I take it you are referring to the atomized suspension technique. There has been a good deal of publicity given this. We have followed

with interest what has been published. The important thing about this is it is only for the disposal of the solids from the sewage and has nothing to do with the treatment of the sewage itself. There are many ways in which solids or sludge can be disposed of. It becomes a question of economics. As yet, we have not received sufficient information to say that this is going to be less expensive than other methods.

Mr. MURPHY: Would you agree that over the last 40 years, according to the authority I quoted to Mr. Menzies, there has been very little done in research concerning this problem?

Dr. BERRY: No; I would not go that far. I think there has been a great deal done. However, I would agree with the statement that the methods fundamentally are the same.

Mr. MURPHY: Yes; that is what I meant.

Dr. BERRY: In other words, we have settling which has been a practice right from the beginning, and in secondary methods we use biological processes. There has been a considerable development in those, but it is still fundamentally the same process and I think will continue to be.

Mr. MURPHY: You are concerned mostly with Ontario?

Dr. BERRY: Yes.

Mr. MURPHY: And that of course includes the Great Lakes.

Dr. BERRY: Yes; our side of them.

Mr. MURPHY: There is a good deal of difference in the quality of the water in the different lakes, is there not? Take lake Erie as compared with lake Huron or lake Superior.

Dr. BERRY: Are you referring to the physical differences or the amount of pollution?

Mr. MURPHY: What I am getting at is there are a lot of cities whose sewage enters the Great Lakes. Does Detroit empty its sewage into the Detroit river which then flows into lake Erie?

Dr. BERRY: Yes. Detroit has a primary treatment plant but the effluent from that plant goes into the Detroit river and then into lake Erie.

Mr. MURPHY: What about other United States cities in Michigan and Ohio.

Dr. BERRY: They have done a great deal to put in primary treatment plants on the boundary waters and they may discharge their effluent into those.

Mr. MURPHY: The solid is not going out.

Dr. BERRY: The solids are kept at the plant. In the primary treatment you take out about 60 per cent of the solids. The rest is finally divided and goes out into the stream.

Mr. MURPHY: What other cities on the Great Lakes empty their sewage into the lakes?

Dr. BERRY: On our side?

Mr. MURPHY: On both sides.

Dr. BERRY: Sault Ste Marie on both sides has been dumping it raw. They both are engaged now in the construction of sewage treatment plants. Sarnia has been discharging raw sewage and is now building a sewage treatment plant. Amherstburg and Windsor have discharged raw sewage but are embarking now on programs.

Mr. MURPHY: I am sorry I am taking up a lot of time on this, but this is my baby and I would like to have it thrashed out. Was it at your suggestion that the chemical and petrochemical and oil industries tried to curb and

lessen the pollution, both air and liquid, going into the river St. Clair. Is that right?

Dr. BERRY: That was a joint program. I think it is fair to say it was a joint program between the international joint commission and our commission. A great deal has been accomplished in that area.

Mr. MURPHY: I believe the industry spent about $3½ million.

Dr. BERRY: I do not have the figures but undoubtedly it is a high amount.

Mr. MURPHY: What are the results?

Dr. BERRY: The results are very encouraging. The pollutants, including the phenol which is an oil waste, have been reduced to a point which meets the objectives of the international joint commission and our commission. The objectives are the same.

Mr. MURPHY: Mr. Chairman, do you intend having Dr. Berry later? I have about half an hour of questioning. This is a big problem for us in Ontario.

The CHAIRMAN: Dr. Berry had planned to return to Toronto at 2:30, but he is agreeable to postponing his trip if we wish to have him back later this afternoon.

Mr. DOUCETT: Doctor, what is the difference in the treatment of water for human consumption in the different municipalities?

Dr. BERRY: Treatment of water for human consumption is a different method entirely; it is filtration and chlorination. The water coming in cannot be diluted to the extent raw sewage is. The aim is to treat water which is not unduly loaded with pollution, whereas in the treatment of sewage biological processes are involved, in order to give a sufficient degree of treatment so that when the effluent is mixed with the water it will not cause an objectionable condition in the stream.

Mr. DOUCETT: So when the water is treated in all the different municipalities, regardless of the system, the water is perfectly harmless for human consumption.

Dr. BERRY: Yes. These treatment processes are quite effective. They will remove and destroy the bacteria. There are certain chemicals, such as phenol, which may create an objectionable taste; it is harmless but may be objectionable.

Mr. DOUCETT: The various treatments may give a difference in taste.

Dr. BERRY: Yes.

Mr. MURPHY: If there are no more questions probably I could finish in five minutes if the committee would agree to putting on record a brief prepared by Dr. Ayers, whom Dr. Berry knows and respects, from the university of Michigan. This is a brief he submitted to the Canadian-American committee on pollution, of which I am chairman. The subject is the probable effects of a gusher oil well in alongshore waters of lake Huron.

The CHAIRMAN: You would like that included as an appendix?

Mr. MURPHY: Yes. It is pertinent to the subject under discussion. Dr. Ayers, as Dr. Berry knows, is one of the authorities on this continent and in fact in the world. What I would like to do is ask permission to have this made a part of our minutes.

The CHAIRMAN: Is that agreed?

Agreed.

Mr. MARTEL: First may I ask a question in respect of the boundary waters. You are referring to the boundary waters between Canada and the United States and the international agreement made in that respect. What

about the boundary waters between provinces? You mentioned the Ottawa river. What about the boundary between two provinces, or a river which has its source outside a province? For instance, in the case of the Ottawa river, do you consult and cooperate with the prevention of pollution of water agencies as far as this river is concerned—or on the pollution problem?

Dr. BERRY: Yes. Interprovincial waters are not under the International Joint Commission, so there is examination and cooperation between the provinces.

In the case of the Ottawa river, we do consult with the Quebec officials. But we are primarily concerned in cleaning up our own side.

Mr. MARTIN (*Timmins*): I notice on page 2 of your brief, at the bottom of the page, there is reference to two surveys that have been made, one in 1913 and the other in 1946-48.

The wording here is:

> In the former, in 1913, sewage was the all-important factor, but in the 1946-48 survey industrial wastes had reached entirely new proportions.

Does that mean that the sewage had decreased?

Dr. BERRY: No. You are quite right: this might be misleading. I did not want to convey the impression that the sewage had decreased; in fact, it had increased. But the industrial waste had gone up tremendously.

Mr. MARTIN (*Timmins*): The other passage to which I wish to refer is on page 5. This deals with the functions of the commission. Possibly this question could not be answered until one has had a look at the act itself. But would you say that under the provisions of this act at the present time the commission has all the authority necessary to look after this problem, provided they can carry it out?

Dr. BERRY: In general terms, I would say yes. There are always, of course, minor details that one would like; but, in general, there is that authority.

I would point out those problems to which I referred in here that still exist.

The CHAIRMAN: Gentlemen, it is now 1.00 o'clock.

Mr. MURPHY: Would you like me to ask my questions, Mr. Chairman?

The CHAIRMAN: Just a minute.

Mr. MARTIN (*Timmins*): I have only one other question, Mr. Chairman. It does not really say so, but on reading the brief through, there appears to have been real progress made since this act was passed in 1957.

Dr. BERRY: There has been, I think it is fair to say.

Mr. MARTIN (*Timmins*): In the cities in which it is in process now.

Dr. BERRY: Yes; and practically all of them are getting on with their program in some form.

Mr. MURPHY: Mr. Chairman, I will just ask one question, with your concurrence. I hate to go over 1:00 o'clock, but if Dr. Berry wants to get away, we will accommodate him, as far as I am concerned.

Dr. Berry, I was referring to this brief of Dr. Ayers' which I am going to present, and I was going to ask you if you would concur.

As you know, they had a gusher not too far from Lake Huron, and they had a platform on which they were going to erect a drilling outfit about half a mile from the shipping channel as it goes into the river St. Clair; and we objected to that.

But the point I am making now is this, that this gusher in the state of Michigan spilled some 50,000 barrels of oil one day and was not capped for

several days. If that did happen—and all that area, practically, was either salt, oil or gas—Dr. Ayers had this to say. I think, gentlemen, this is very alarming. This is from page 6. He is referring to this particular well. And they did have another gas well, of which the flames could be seen for 50 miles, and they could not get it capped for some seven or eight days.

Using the information from the above tables—

which is on record here:

> —we may consider the effects of a runaway oil well producing 3,000 barrels per hour as was reported in the case of the Fulk-Mann No. 1 (*Ann Arbor News*, November 2, 1959). In 18.3 hours of discharge this well would have produced enough oil to cover the entire surface of Lake Huron (23,102 square miles) with an oil film sufficiently thick to show traces of color ($6 \times 10^{-6}$ inches). In an additional 8.25 hours, enough oil would have been produced to also cover the entire surface of the St. Clair river, Lake St. Clair, the Detroit river (490 square miles), and Lake Erie (9,930 square miles) with a film of the same thickness. Thus, an offshore run-away oil well of the same magnitude as the Fulk-Mann No. 1 would discharge enough crude oil to cover Lakes Huron, Erie and the connecting waterway with a perceptible oil film in a period of slightly more than one day. The Fulk-Mann No. 1 flowed uncontrolled for more than three days before it was capped.

Then he goes on to say that the danger from a cigarette light would be serious, with the damage that might ensue to shipping as well as to life.

I assume, Dr. Berry, that you concur in that?

Dr. BERRY: I do not know the basis of his statement, but I would say that any large discharge of oil would create very difficult conditions.

Mr. MURPHY: It would apply to fish life, water intakes, and everything else?

Dr. BERRY: Yes.

The CHAIRMAN: Is this drilling occurring on the American or on the Canadian side?

Dr. BERRY: There has been no drilling recently on the Ontario side, but there have been a number of wells drilled on our side over a period of years.

Mr. MURPHY: In lake Erie?

Dr. BERRY: Yes, but those are gas wells, not oil wells.

Mr. MURPHY: They do not know whether they can get oil or gas when they are drilling.

The CHAIRMAN: That will be all. Thank you, gentlemen.

## APPENDIX "A"

(Note: Brief submitted by Mr. Murphy, a member of the committee, and prepared by Dr. Ayers of the University of Michigan, Ann Arbor, Michigan.)

## BRIEF: THE PROBABLE EFFECTS OF A GUSHER OIL-WELL IN THE ALONGSHORE WATER OF LAKE HURON

### Introduction

Experience with oil and gas wells drilled in Lake Erie has shown that run-aways by wells of either sort are possible. There are now proposals and leases for the drilling of wells in Lake Huron, where the lake currents, shallow connecting waterways, and metropolitan areas pose problems much more serious than are present in the region around northern Lake Erie; it is of prime importance therefore, that serious consideration be given to the possible consequences of run-aways (that appear to be inevitable when any material number of wells are drilled). Consideration of the effects of runaway wells did not precede the drilling of wells in Lake Erie, that more serious effects of runaways in the Lake Erie wells has not been observed is a fortuitous result of the limited population of that area, and of the lack of municipal water supply installations in that area. These fortuitous conditions do not exist down-lake from wells proposed in Lake Huron.

### Purpose

It is the purpose of this brief to summarize the several probable effects of runaways such as that experienced in October-November 1959 at the Perry Fulk-Mann Oil Well No. 1 in Hillsdale County, Michigan, but transposing those effects into the waters of Lake Huron.

### Assumptions

In making this transposition the following assumptions are made:

1. Drilling in Lake Huron would be rotary drilling carried on from an emergent platform;
2. Gusher conditions result from failure of a preventer or preventers in the upper end of the pipe [as was the case in Fulk-Mann No. 1 (*Detroit News,* 2 November 1959)];
3. The gusher discharges from platform level, above the surface of the lake;
4. The gusher forms an aerial plume of oil, gas, oil-well water, drilling mud, and debris;
5. The plume extends 150 to 200 feet into the air [as was the case at Fulk-Mann No. 1 (*Ann Arbor News,* 31 October 1959)].

### The Gusher Plume

Because reservoir pressures, which cause the free discharge of a gusher, run from 500 to 1500 pounds per square inch (1), the pressurized discharge from the pipe would have an atomizing effect and produce intimate mixtures of the materials being discharged. Gushers have been known to discharge 50,000 to 100,000 barrels per day (1); the Fulk-Mann No. 1 gusher was estimated to have discharged 50,000 barrels during its first day of runaway (*Ann Arbor News,* 2 November 1959).

Material from the gusher's aerial plume fall back to the water at varying distances downwind, according to the sizes of the individual masses of plume

material. Heavy fall-back of virtually unbroken masses of plume material would occur just downwind of the well. Large drops and spatter of plume material would fall out somewhat farther downwind, followed by small droplets and spray still farther away. The extreme downwind edge of the visibe plume would consist of a high concentration of vapors and gases, beyond which a "tail" of disagreeable odors would be airborne downwind for numbers of miles. The odor tail of Fulk-Mann No. 1 reached Lansing, 55 miles away (*Ann Arbor News*, 3 November 1959). Well gases produce the sensation of inebriation, and act as a powerful narcotic, in persons near the well (1).

HYDROCARBONS SEPARATED FROM PONCA CRUDE OIL

| Formula | Hydrocarbon | Percent by Volume in Crude Oil |
|---|---|---|
| Paraffins | | |
| $C_5H_{12}$ | 2-Methylbutane | — |
| $C_5H_{12}$ | n-Pentane | — |
| $C_6H_{14}$ | 2, 2-Dimethylbutane | 0.04 |
| $C_6H_{14}$ | 2, 3-Dimethylbutane | 0.08 |
| $C_6H_{14}$ | 2-Methylpentane | 0.40 |
| $C_6H_{14}$ | 3-Methylpentane | 0.30 |
| $C_6H_{14}$ | n-Hexane | 1.80 |
| $C_7H_{16}$ | 2, 2-Dimethylpentane | 0.02 |
| $C_7H_{16}$ | 2, 4-Dimethylpentane | 0.08 |
| $C_7H_{16}$ | 2, 3-Dimethylpentane | 0.10 |
| $C_7H_{16}$ | 2-Methylhexane | 0.70 |
| $C_7H_{16}$ | 3-Methylhexane | 0.50 |
| $C_7H_{16}$ | 3-Ethylpentane | 0.05 |
| $C_7H_{16}$ | n-Heptane | 2.30 |
| $C_8H_{18}$ | 2, 2-Dimethylhexane | 0.01 |
| $C_8H_{18}$ | 2, 5-Dimethylhexane | 0.06 |
| $C_8H_{18}$ | 2, 4-Dimethylhexane | 0.06 |
| $C_8H_{18}$ | 2, 2, 3-Trimethylpentane | 0.004 |
| $C_8H_{18}$ | 3, 3-Dimethylhexane | 0.03 |
| $C_8H_{18}$ | 2, 2, 4-Trimethylpentane | 0.005 |
| $C_8H_{18}$ | 2, 3, 3-Trimethylpentane | 0.006 |
| $C_8H_{18}$ | 2, 3-Dimethylhexane | 0.07 |
| $C_8H_{18}$ | 2-Methyl-3-ethylpentane | 0.06 |
| $C_8H_{18}$ | 2-Methylheptane | 0.90 |
| $C_8H_{18}$ | 4-Methylheptane | 0.20 |
| $C_8H_{18}$ | 3, 4-Dimethylhexane | 0.13 |
| $C_8H_{18}$ | 3-Methyl-3-ethylpentane | 0.02 |
| $C_8H_{18}$ | 3-Ethylhexane | 0.09 |
| $C_8H_{18}$ | 3-Methylheptane | 0.30 |
| $C_9H_{20}$ | 2, 2, 5-Trimethylhexane | 0.002 |
| $C_8H_{18}$ | n-Octane | 1.90 |
| $C_9H_{20}$ | 2, 3, 5-Trimethylhexane | 0.03 |
| $C_9H_{20}$ | 2, 6-Dimethylheptane | 0.05 |
| $C_9H_{20}$ | 2, 3-Dimethylheptane | 0.05 |
| $C_9H_{20}$ | 4-Methyloctane | 0.10 |
| $C_9H_{20}$ | 2-Methyloctane | 0.40 |
| $C_9H_{20}$ | 3-Methyloctane | 0.10 |
| $C_9H_{20}$ | n-Nonane | 1.80 |
| $C_{10}H_{22}$ | 4-Methylnonane | 0.10 |
| $C_{10}H_{22}$ | 2-Methylnonane | 0.30 |
| $C_{10}H_{22}$ | 3-Methylnonane | 0.10 |
| $C_{10}H_{22}$ | n-Decane | 1.80 |
| $C_{11}H_{24}$ | N-Undecane | 1.70 |
| $C_{12}H_{26}$ | n-Dodecane | 1.70 |
| $C_{13}H_{28}$ | n-Tridecane | 1.60 |
| $C_{14}H_{30}$ | n-Tetradecane | 1.40 |
| $C_{15}H_{32}$ | n-Pentadecane | 1.20 |
| $C_{16}H_{34}$ | n-Hexadecane | 1.00 |
| $C_{17}H_{36}$ | n-Heptadecane | 0.90 |
| Cycloparaffins | | |
| $C_5H_{10}$ | Cyclopentane | 0.05 |
| $C_6H_{12}$ | Methylcyclopentane | 0.90 |
| $C_6H_{12}$ | Cyclohexane | 0.70 |
| $C_6H_{14}$ | 1, 1-Dimethylcyclopentane | 0.20 |
| $C_7H_{14}$ | 1-trans-3-Dimethylcyclopentane | 0.90 |
| $C_7H_{14}$ | 1-cis-3-Dimethylcyclopentane | 0.20 |

HYDROCARBONS SEPARATED FROM PONCA CRUDE OIL—*Concluded*

| Formula | Hydrocarbon | Percent by Volume in Crude Oil |
|---|---|---|
| Cycloparaffins—*Concluded* | | |
| $C_7H_{14}$ | 1-trans-2-Dimethylcyclopentane | 0.50 |
| $C_7H_{14}$ | Methylcyclohexane | 1.60 |
| $C_7H_{14}$ | Ethylcyclopentane | 0.20 |
| $C_8H_{16}$ | 1, 1, 3-Trimethylcyclopentane | 0.30 |
| $C_8H_{16}$ | 1-trans-2-cis-4-Trimethylcyclopentane | 0.20 |
| $C_8H_{16}$ | 1-trans-2-cis-3-Trimethylcyclopentane | 0.30 |
| $C_8H_{16}$ | 1, 1, 2-Trimethylcyclopentane | 0.06 |
| $C_8H_{16}$ | 1-cis-2-trans-4-Trimethylcyclopentane | 0.01 |
| $C_8H_{16}$ | 1-cis-2-trans-3-Trimethylcyclopentane | 0.07 |
| $C_7H_{14}$ | Cycloheptane | 0.01 |
| $C_8H_{16}$ | 1-trans-4-Dimethylcyclohexane | 0.25 |
| $C_8H_{16}$ | 1, 1-Dimethylcyclohexane | 0.06 |
| $C_8H_{16}$ | 1-cis-3-Dimethylcyclohexane | 0.63 |
| $C_8H_{16}$ | 1-Methyl-trans-3-ethylcyclopentane | — |
| $C_8H_{16}$ | 1-Methyl-cis-3-ethylcyclopentane | 0.12 |
| $C_8H_{16}$ | 1-Methyl-trans-2-ethylcyclopentane | 0.14 |
| $C_8H_{16}$ | 1-Methyl-1-ethylcyclopentane | 0.03 |
| $C_9H_{18}$ | 1, 1-cis-3-trans-4-tetramethylcyclopentane | 0.04 |
| $C_8H_{16}$ | 1-trans-2-Dimethylcyclohexane | 0.31 |
| $C_8H_{16}$ | 1-cis-4-Dimethylcyclohexane | 0.09 |
| $C_8H_{16}$ | 1-trans-3-Dimethylcyclohexane | 0.07 |
| $C_8H_{16}$ | Isopropylcyclopentane | 0.01 |
| $C_9H_{18}$ | Tetramethylcyclopentane | 0.11 |
| $C_8H_{16}$ | 1-Methyl-cis-2-ethycyclopentane | 0.04 |
| $C_8H_{16}$ | 1-cis-2-Dimethylcyclohexane | 0.06 |
| $C_8H_{16}$ | n-Propylcyclopentane | 0.06 |
| $C_8H_{16}$ | Ethylcyclohexane | 0.37 |
| $C_9H_{18}$ | 1, 1, 3-Trimethylcyclohexane | 0.20 |
| $C_9H_{18}$ | Trimethylcyclohexane | 0.20 |
| $C_9H_{18}$ | Monocycloparaffin | — |
| $C_9H_{16}$ | Dicycloparaffin | — |
| $C_{10}H_{18}$ | trans-Decahydronaphthalene | — |
| $C_{11}H_{20}$ | Dicycloparaffin | — |
| Aromatic Hydrocarbons | | |
| $C_6H_6$ | Benzene | 0.20 |
| $C_7H_8$ | Toluene | 0.50 |
| $C_8H_{10}$ | Ethylbenzene | 0.20 |
| $C_8H_{10}$ | p-Xylene | 0.10 |
| $C_8H_{10}$ | m-Xylene | 0.50 |
| $C_8H_{10}$ | o-Xylene | 0.30 |
| $C_9H_{12}$ | Isopropylbenzene | 0.07 |
| $C_9H_{12}$ | n-Propylbenzene | 0.09 |
| $C_9H_{12}$ | 1-Methyl-3-ethylbenzene | 0.20 |
| $C_9H_{12}$ | 1-Methyl-4-ethylbenzene | 0.06 |
| $C_9H_{12}$ | 1, 3, 5-Trimethylbenzene | 0.10 |
| $C_9H_{12}$ | 1-Methyl-2-ethylbenzene | 0.09 |
| $C_{10}H_{14}$ | tert-Butylbenzene | 0.01 |
| $C_9H_{12}$ | 1, 2, 4-Trimethylbenzene | 0.50 |
| $C_9H_{12}$ | 1, 2, 3-Trimethylbenzene | 0.10 |
| $C_{10}H_{14}$ | 1-Methyl-3-propylbenzene | — |
| $C_{10}H_{14}$ | 1, 2-Diethylbenzene | — |
| $C_{10}H_{14}$ | 1-Methyl-2-propylbenzene | — |
| $C_{10}H_{14}$ | 1, 4-Dimethyl-2-ethylbenzene | — |
| $C_{10}H_{14}$ | 1, 3-Dimethyl-4-ethylbenzene | — |
| $C_{10}H_{14}$ | 1, 2-Dimethyl-3-ethylbenzene | — |
| $C_{10}H_{14}$ | 1, 2, 4, 5-Tetramethylbenzene | — |
| $C_{10}H_{14}$ | 1, 2, 3, 5-Tetramethylbenzene | — |
| $C_{11}H_{16}$ | Alkylbenzene | 0.06 |
| $C_{10}H_{14}$ | 1, 2, 3, 4-Tetramethylbenzene | 0.20 |
| $C_{11}H_{16}$ | 1, 3-Dimethyl-4-n-propylbenzene | 0.03 |
| $C_{10}H_{12}$ | 1, 2, 3, 4-Tetrahydronaphthalene | 0.02 |
| $C_{11}H_{16}$ | 1, 2-Dimethyl-4-n-propylbenzene | 0.03 |
| $C_{11}H_{16}$ | Trimethylethylbenzene | 0.04 |
| $C_{10}H_8$ | Naphthalene | 0.06 |
| $C_{11}H_{14}$ | Benzene-cyclopentane | 0.04 |
| $C_{11}H_{14}$ | 6-Methyl-1, 2, 3, 4-Tetrahydronaphthalene | 0.09 |
| $C_{11}H_{14}$ | 5-Methyl-1, 2, 3, 4-tetrahydronaphthalene | 0.08 |
| $C_{11}H_{10}$ | 2-Methylnaphthalene | 0.20 |
| $C_{11}H_{10}$ | 1-Methylnaphthalene | 0.10 |
| $C_{12}H_{12}$ | 2, 6-Dimethylnaphthalene | — |
| $C_{13}H_{14}$ | Trimethylnaphthalene | — |

The parts of the plume are here discussed separately, in order of their sequence of fall-back, for consideration of their different effects on the water.

*Zone of Heavy Fall-Back*

Nearest the well large masses of plume material would fall heavily into the water and be carried below the water surface by the momentum of their fall; most of this material would then rise by its buoyancy to the water surface. Heavy debris such as oil-impregnated muds would sink to the bottom, carrying with it a certain amount of adhering oil containing dissolved gases. These sediments become a source of turbidity, oil tastes, odors, and soluble compounds in the subsurface water. Although oily sediments of this sort may be expected to be limited in amount, they do provide a direct source of oil and gas contamination into the subsurface water. The layer of oily sediment on the bottom would be detrimental to bottom-living organisms. They might be physically smothered, adversely affected by the toxicity of soluble oil-fractions, or driven from the area.

Oil-well water included in the material falling back would in large part escape into the lake while the fallen material was temporarily beneath the surface. Oily components of the heavy fall-back would float to the lake surface where they could again be carried back down into the lake by additional falling material. Materials falling into and through the surface oil-film would cause mechanical mixing of oil and surface water, promoting the formation of oil-water emulsions (see page 3) and causing additional pollution of the lake water.

Thus, in the zone of heavy fall-back, there would be three sources of pollution: Oil-impregnated muds, well-waters and gases escaping into the surface layers of the lake from temporarily submerged fall-back material, and oil-water emulsions formed at the oil-water interface by mechanical mixing as the oil and water are churned by heavy fall-back.

Contaminants from oily bottom sediments would be distributed by the bottom currents of the lake; contaminants in the surface water and upper water layers would be distributed by the lake's surface currents that are formed by winds of preceding days (2); and the surface oil-film (releasing soluble oil fractions to the water) would spread down wind under the influence of the winds of the day in question. The three distributions would, in general, not be the same.

*Large Drops and Spatter*

In the zone of large drops and spatter, materials falling from the gusher plume would be of the same composition as in the zone of heavy fall-back except that the smaller sizes of the individual masses would allow much of the included gas to escape during their flight in the air. The mechanical and sedimentary effects of fall-back in this zone would be essentially the same as in the zone of heavy fall-back except these effects would be reduced in scale, since the smaller masses contain less material and have less momentum.

*Small Droplets and Spray*

The zone of large drops and spatter grades into a zone of small droplets and spray, in which the fall-back has one important and significant additional characteristic. The small droplets and spray have a large surface-area-to-volume ratio and much of the included gas may be expected to escape into the air before the fall-back reaches the lake surface. Fall-back of these small particles would be composed primarily of crude oil and well-water; their small sizes and rainlike nature would produce little mechanical mixing with the lake water, and emulsions would not likely be formed in this manner in

this zone. However, the atomizing effect which breaks drops into spray produces charges of static electricity on the spray droplets. The development of charged droplets in an oil well plume would contribute greatly to the ability of oil and water to form emulsions (5). Charged droplets of oil uniting in the air with oppositely charged water droplets form oil-water emulsions which will settle through the surface oil film and enter the lake water.

The total amount of electrical charges developed in the plume is probably too small to ever produce lightning discharges in the plume, but lightning does occur in the plumes of volcanos where similar physical conditions prevail (3), and the development of charged particles (and lightning) in thunderclouds is well known (4).

Emulsions of water in oil and of oil in water would both be formed, some by mechanical mixing in the zone of heavy fall-back and some by the attraction of charged particles in the zone of small droplets and spray. Emulsions of water in oil are relatively unstable and break down readily, but oil-in-water emulsions are quite stable and are not easily broken by mechanical or thermal action (6). Emulsions of the latter sort may be expected to last while being transported to considerable distances by water currents. It is emulsions of the oil-in-water type which may be expected to reach, and give trouble in, municipal water-treatment plants and industrial installations using lake water.

*Extreme Down-wind Edge of Visible Plume, and "Odor Tail"*

The extreme down-wind edge of the visible gusher plume would consist of a high concentration of vapors and gas beyond which a "tail" of disagreeable odors would extend for numbers of miles down-wind. The vapor and gas zone would contain natural gas (both that emerging free and that escaping from solution in the oil) and well-water vapor with its gaseous components (from the evaporation of fine droplets of well-water in the plume), as well as vapors and odors from the crude itself.

The raw gas escaping from the well pipe (casinghead gas) has the following composition (22):

| | |
|---|---|
| Methane | chief component |
| Ethane<br>Propane<br>Butane<br>Pentane<br>Hexane | minor constituents often present |
| Heptane<br>Octane<br>Nonane | minor constituents sometimes present |
| Hydrogen<br>Carbon monoxide | rarely present |
| Nitrogen<br>Carbon dioxide<br>Hydrogen sulphide | principal impurities |
| Helium | minor impurity |

The compositions of casinghead gases are highly variable, but an indication of the probable unpleasant nature of casinghead gas from a gusher in Lake Huron may be obtained from the fact that odors from the Fulk-Mann #1 gusher inspired about 3500 calls to police and firemen in Jackson (more than 20 miles away), and in Lansing (55 miles away): "Lansing police and firemen have received many calls asking information on the strange odor

which many Lansingites have noticed. Two fire calls have been made, only to find that the reason was the Jonesville well." (*Ann Arbor News*, 3 November 1959).

## Contaminants of Oil Well Origin

*Lighter Hydrocarbons*

The lighter hydrocarbons in crude oil have a significant direct solubility in water. These lighter hydrocarbons (eight or fewer carbon atoms per molecule), see appendix, make up about 20% of at least some crude oils (7), and many of these lighter hydrocarbons are definitely toxic to aquatic organisms (8) as well as being sources of taste and odor (9-20). These lighter hydrocarbons would enter the lake water from oil-impregnated bottom sediments, by direct dissolution at the water surface under the oil-film, and by dissolution from the oil phases of oil-water emulsions. In addition, the entrance of well-water into the lake would introduce these hydrocarbons, also, for well-waters become saturated with them while in contact with the oil in the underground reservoir (21).

*Oil-well Waters*

The composition of oil-well waters is variable, but in the Michigan-Ontario fields they would probably be brines. The commercial exploitation of Michigan brines at Midland by the Dow Chemical Company is well known, and the strongest natural brine yet recorded (in 1945) was from Gulf Oil Salina Well No. 1 near Bay City (23). This brine was; 4.3% dissolved mineral matter and had a strong organic odor. The specific gravity of this brine was greater than that of a saturated solution of calcium chloride, and saturated solutions of potassium chloride or magnesium chloride would be considerably lighter. The brine consisted of a mixture of chlorides, plus potassium bromide, and was viscous and oily in appearance. Its specific gravity was 1.458 and the brine was so hygroscopic that it evolved considerable heat on the addition of fresh water (23).

*Odors and Poisonous Gases*

Limestone oils are accompanied by disagreeable odors and poisonous gases (24). Oil fields of Michigan, Indiana, Ohio, and Ontario are apparently largely producers from limestone. The Deep River field of Michigan produces from a dolomitic member of the Devonian Rogers City Limestone (25). Gulf Oil Salina #1 produced from the Silurian Salina dolomite at Bay City (23). The Lima-Indiana field of Indiana and Ohio produces from the dolomitized portion of the Ordovician Trenton limestone (26). The Belcher field of Ontario produces from dolomitic members of the Silurian Salina limestone (27). Hough (29) shows that the Lake Huron basin is underlain by Missippian, Devonian, Silurian, and Ordovician rocks over the pre-Cambrian basement structure. Martin (30) lists twelve oil-producing strata in the rock series which underlie Lake Huron; of these, eight are dolomites and/or limestones. It is therefore likely that oils coming from Lake Huron drilling operations would be limestone oils characterized by disagreeable odors and poisonous gases. The occurrence of limestone oils, in particular, gives further weight to the urgency of examining the consequences of pollution of the water of Lake Huron by crude oil and brines from run-away oil wells.

## Distribution of Oil on the Lake Surface

The primary effect of a run-away well upon the surface of the lake would be the deposition of a heavy oil film upon the water surface. This oil layer would be thickest just downwind from the well. This oil layer would be thickest just downwind from the well and would extend out from the well in a streamlined "teardrop" shape with its greatest extension directly downwind from the well. Since the distribution of the surface layer responds chiefly to the winds, the long "tail" of the oil layer would probably move about on the lake surface as the winds changed direction. Since the winds of Lake Huron are 50-55% from the north, northwest, west, and southwest, the tail would go southward or eastward in the majority of cases (Table 1).

Table 1

Frequency of wind directions over Lake Huron (31)

Data of Sault St. Marie.

| | N | NE | E | SE | S | SW | W | NW | 12% calms |
|---|---|---|---|---|---|---|---|---|---|
| 4—15 mph .... | 5% | 5% | 10% | 18% | 3% | 9% | 9% | 17% | |
| 16—31 mph .... | | | | 2% | | 2% | 2% | 6% | |
| | 5% | 5% | 10% | 20% | 3% | 11% | 11% | 23% | |

from westerly quarters (SW, W, NW) 45% and from N 5%, total 50%

Data of Detroit

| | N | NE | E | SE | S | SW | W | NW | 8% calms |
|---|---|---|---|---|---|---|---|---|---|
| 4—15 mph .... | 6% | 8% | 7% | 8% | 8% | 12% | 10% | 13% | |
| 16—31 mph .... | 2% | 2% | | 2% | 2% | 6% | 3% | 3% | |
| | 8% | 10% | 7% | 10% | 10% | 18% | 13% | 16% | |

from westerly quarters (SW, W, NW) 47% and from N 8%, total 55%

Because the majority of active winds (calms excluded) are from the north and the three westerly directions, the oil film would be expected to trend eastward most of the time, and Canadian shores would be likely to receive the greatest burden of the oil film. The prevailing winds would also be expected to carry the odor tail from the plume of the gusher far into Canada.

The thickness of the surface oil layer and the concentration of well gases would be greatest in the zone of heavy fall-back just downwind from the well site. In off-shore runaway wells, the well site would be the region of a human activity most strongly effected by the inebriating and narcotic effects of the well gases and the area most subject to fire hazard. Either the gusher plume or the layer of oil on the lake surface could be ignited directly as a result of sparks, smoking, etc. Also, initial ignition of only the gusher plume would result in the cascading of burning material down upon the oil-covered water and the probable consequent ignition of the oil layer. If ignited, the flaming oil layer would float on the surface of the lake and be carried along by the winds. In contrast with inland oil operations, extremely large areas might be subjected to the wind-borne flaming oil layer carried away from the site of a run-away offshore oil well.

No data are presently available on the thickness of crude-oil film necessary to support combustion. Thin films of oil would be cooled by the underlying lake water and therefore would be less likely to burn. The thickness of the oil layer near the well would provide insulation against the cooling effect of the underlying lake water and thus increase the possibility of ignition of the oil layer in the region where the fire hazard is the greatest. Experiments

in New York Bay indicate that an oil of 175°F. flash point floating on water at 54°F. could not be ignited by any ordinary means unless the thickness exceeded 0.064 in. (32). Lighter fractions or dilutions might be ignited more easily. Experience with fires of floating oil has shown that much damage to shore-line property may result (33).

The thick oil layer in the neighborhood of the well would tend to thin out under the effects of wind and water currents and could cover large areas of the lake surface. Table 2 gives the relationship of oil film thickness and appearance to the quantity of oil present, as determined by the American Petroleum Institute (34).

Table 2.

Thickness, appearance, and gallons per square mile of oil films on water.

| Approximate thickness of film, inches | | Approximate number of gallons to form 1 square mile of film |
|---|---|---|
| 0.0000015 | Barely visible under most favorable light conditions | 25 |
| 0.0000030 | Visible as silver sheen on surface of water | 50 |
| 0.0000060 | First trace of color may be observed | 100 |
| 0.0000120 | Bright bands of color are visible | 200 |
| 0.0000400 | Colors begin to turn dull | 666 |
| 0.0000800 | Colors are much darker | 1332 |

Table 3 gives the area of lake surface that would be covered by 100 barrels of crude oil (4200 gallons) if it were distributed in the six film thicknesses indicated in Table 2.

Table 3.

Area of the lake surface which would be covered by 100 barrels of crude oil.

| Oil Concentration | Area Covered |
|---|---|
| 25 gal/mi² | 168mi² |
| 50 | 84 |
| 100 | 42 |
| 200 | 21 |
| 666 | 6.3 |
| 1332 | 3.6 |

Using the information from the above tables, we may consider the effects of a runaway oil well producing 3000 bbl/hr as was reported in the case of the Fulk-Mann #1 (*Ann Arbor News*, 2 November 1959). In 18.3 hours of discharge this well would have produced enough oil to cover the entire surface of Lake Huron (23,102 square miles) with an oil film sufficiently thick to show traces of color ($6 \times 10^{-6}$ in.). In an additional 8.25 hours, enough oil would have been produced to also cover the entire surface of the St. Clair River, Lake St. Clair, the Detroit River (490 square miles), and Lake Erie (9,930 square miles) with a film of the same thickness. Thus, an offshore

run-away oil well of the same magnitude as the Fulk-Mann #1 would discharge enough crude oil to cover Lakes Huron, Erie and the connecting waterway with a perceptible oil film in a period of slightly more than one day. The Fulk-Mann #1 flowed uncontrolled for more than three days before it was capped.

The direct effects of an oil film on the water surface would be property damage, injury to wild-life, and sufficient pollution of the water to make it unfit for recreational, domestic, and industrial uses. In particular: mixtures of brine and oil cause skin irritation to bathers (35); oil films foul beaches, boats, fishing gear, piers, etc. . . . (36); and large numbers of water-fowl have been destroyed by oil slicks on the water surface (37, 38). The danger to water-fowl is vividly described by Taning in an article that appeared in a Swedish journal, Sveriges Natur, in 1952 (39):

> The danger for birds lies in that a great part of the down becomes glued up, so that the protecting air strata between this and the body is destroyed in such spots, or becomes so thin that it does not produce warmth insulation. When one examines the fine oil-impregnated down under the microscope it is understandable that all insulation is destroyed. The bird's natural and necessary warmth protection has been lost and the bird freezes, and in most cases flies from its native element, the sea, inland where it meets its death (certainly most frequently from cold). Its flying powers are often decreased so it must swim to land. In severe cases the bird dies before it reaches land. I have seen Razorbills and Guillemots far out to sea, so soaked with water that they could only keep their head and neck above the surface. Without doubt far out to sea masses of birds have sunk to the bottom without having been observed, so that those which reach land and are observed are perhaps only a fractional part of the number that have really perished.

Part of the surface oil film may become emulsified with the lake water, and the water soluble fraction of the crude oil would diffuse into wide regions of the lake as the oil film spreads over the water surface. In the event of an oil-film fire, the heat of the fire may cause "cracking" of a portion of the oil and produce additional water-soluble organic compounds not found in the original crude oil.

*Effects on Municipal Water Supplies*

The water-soluble fractions of the crude oil, together with the oil-in-water emulsions, introduce tastes and odors into the raw water; turbidity, surface films and irridescence are produced in water plants as the emulsions are broken in the process of water treatment (40). This water pollution, as well as being a source of complaint from water consumers, increases the difficulty and cost of water treatment for municipal water supplies (41, 42).

Halstrick indicates that odors are just detectable in waters containing only 2.5 ppm of petroleum oil (40). Kirkor (43) gives the minimum detectable concentration of raw petroleum as 0.1 to 0.5 ppm. Baylis observed that a dilution of 1 gal. of waste water from an oil refinery with 1600 gal. of Lake Michigan water was necessary to reach a just detectable odor level (44). Experience in water treatment at Whiting, Indiana, has indicated that treatment of waters requiring more than a 100:1 dilution to reach the odor threshold may not be economically justified (42).

The presence of taste and odor is of special importance to the food processing industry; examples are the beverage industries, and canneries where flowing water is used to transport the foods being processed as well as in the production of the food products (45). Oil films are detrimental in papermaking where oil spots may seriously affect the quality of the paper. Further, the water used for making concrete should be free of oils (45). In steam production, the presence of oil in boiler feedwater may cause damage to the power installation, hence, the American Boiler Manufacturers Association has recommended that the total quantity of oil or grease shall not exceed 7 ppm in the boiler water (46). Powell (47) recommends that:

> No oil should be present in boiler feedwater. Serious damage has resulted from only a few parts per million of oil in feedwater fed to high-pressure boilers. When oil is present in the feedwater, it forms deposits on the boiler tube surfaces, preventing proper heat transfer, thus causing overheating and final failure of the metal.

*Effects on Fish and Aquatic Life*

The pollution of water by oil has a two-fold effect: the persistence of the oil itself, and the inhibition of the oxidation of other pollutants in the water (48). The Committee on the Prevention of Pollution of the Sea by Oil, under the British Ministry of Transport, discusses the destruction of eel grass (*Zostera marina*) as a result of oil pollution, and describes the subsequent destruction of aquatic life and the effects upon the shore line (49). The eel grass provided a habitat for fish, and food for wildfowl, as well as forming an effective breakwater for the protection of the shoreline. The destruction of the eel grass resulted in a decrease of mollusks and crustaceans, caused the wildfowl to move, and permitted erosion of the shoreline. Oily substances may possibly be harmful to fresh-water aquatic life in the following manners: (50, 51)

1. Free oil and emulsions may adhere to the gills of fish and interfere with respiration (52). Within limits, however, fish have a defensive mechanism to combat such action: they can secrete a mucous film to wash away irritants. If the concentration of oil is too heavy, however, oil will accumulate on the gills and cause asphyxia.
2. Free oil and emulsions may coat and destroy algae and other plankton, thereby removing a source of fish food. The coated organisms may agglomerate with suspended solids and settle to the bottom of the lake.
3. Settleable oily substances may coat the bottom, destroy benthal organisms, and interfere with spawning areas.
4. Soluble and emulsified material, ingested by fish, taint the flavor of the flesh.
5. Organic materials may deoxygenate the waters sufficiently to kill fish.
6. Water-soluble principles may exert a direct toxic action on fish or fish-food organisms. Such toxicity may be acute or chronic. Acute toxicity will produce death or debility in 96 hours or less. Chronic toxicity exerts a long-time effect through an accumulative action or through subtle changes in the ecology. By its very nature, chronic toxicity is difficult to detect and even more difficult to prove.

Table 4 gives the lethal concentrations of a number of substances either found in, or derived from, crude oils.

TABLE 4

TOXICS

| Compound | % of Ponca Crude Oil (Appendix) | Toxic Conc. (time) | Fish | Authority |
|---|---|---|---|---|
| Benzene | 0.20% | 10 ppm | white roach | 53 |
| | | 35–37 ppm (1 hr) | sunfish | 54 |
| | | 386 ppm (96 hrs) | mosquitofish | 55 |
| Crude oil | | 0.3 ppm | fresh water fish | 56 |
| Cyclohexane | 0.70% | 10 ppm | white roach | 53 |
| | | 15,500 ppm | mosquitofish | 55 |
| Heptane | 2.30% | 4,924 ppm | mosquitofish | 55 |
| Hydrogen sulfide | | 0.086 ppm | brook trout | 57 |
| Methyl cyclohexane | 1.60% | 50 ppm | white roach | 53 |
| Napthalene | 0.06% | 40 ppm | perch | 58 |
| | | 4–5 ppm (1 hr) | sunfish | 54 |
| | | 150 ppm | mosquitofish | 55 |
| Naphthenic acid | | 5 ppm (36–48 hrs) | pickerel | 57 |
| Phenols* | | 0.5 ppm (9 hrs) | trout | 57 |
| Sulfur Dioxide | | 10 ppm (10 min) | trout | 57 |
| Toluene | 0.50% | 61–65 ppm (1 hr) | sunfish | 54 |
| Xylene | 0.90% | 4–5 ppm (1 hr) | sunfish | 54 |

*Fish tend to swim toward water polluted with phenols (59).

Some of the toxic hydrocarbons found in crude oil are: benzene, ethylene, methane, naphthalene, pentane, pentene, petroleum benzin, phenanthrene, toluene, and xylene. Common toxic petroleum derivatives are: phenols, creosols, pyridine, quinoline, mercaptans, organic acids, aldehydes, and similar compounds (50). Also present are organic sulphur compounds, hydrogen sulfide, carbon dioxide, and inorganic salts (60).

*Effect of Pollution by Oil-Well Waters*

The composition of typical oil-well brines is similar to that of the exceptional brine mentioned on page 4, but with a smaller concentration of solid matter. Table 5 gives the analysis of a typical brine from a California oil field: (61)

Table 5

| | |
|---|---|
| Iodine | 35 ppm |
| Na | 9,413 ppm |
| Ca | 552 ppm |
| Mg | 291 ppm |
| Chloride | 16,100 ppm |
| Bicarbonate | 464 ppm |
| Sulfate | 8 ppm |
| Silica | 60 ppm |
| Iron Oxide and Alumina | 5 ppm |
| Volatile and Organic Matter | 1,810 ppm |

The chemical activity of these brines is indicated by the damage to the pipelines used to carry the brines from the oil field to iodine-reclamation plants, as experienced by the Dow Chemical Company: (61) "These lines are subject to considerable corrosion. Transite pipe has solved the problem and is gradually replacing the existing steel pipes". The important point to consider here is that steel pipes subjected to the corrosive effects of oil-field brines may, in time, be deteriorated to the point where they may leak their contents into the surrounding area, and that the transite replacements do not have the mechanical strength of a similar steel pipe.

Although there are wide variations encountered in the field, the average crude oil contains approximately 20 per cent of brines (62). The concentration of solutes in these waters is many times greater than that in modern sea waters (63). These waters carry many of the water-soluble components of the earlier sections of this brief. In areas of high concentration of these waters of high solid content, living organisms are subject to dehydration by the osmotic effects of the dissolved salts in the water. These waters are also important sources of taste and odor pollution.

*Conclusion*

During the past two years, a Trenton (Limestone) Oil Field of considerable size and length has been developed in Calhoun, Jackson, and Hillsdale counties of Michigan. During that time, some 150 oil wells have been completed, some 60 dry holes have been completed, and approximately 60 wells are being drilled at this time. During that time there were three major blowouts. One made large quantities of oil and gas while it was out of control. The other two made largely natural gas. (64)

The following statement is from L. W. Price, a petroleum geologist with the State of Michigan Department of Conservation, regarding the recent blowouts and oil operations in Michigan: (64)

> To be specific in regard to the blowouts mentioned, it should be understood that these blowouts occurred in spite of the fact that the wells were properly equipped for control. Blowout preventers were installed and the wells were properly cased and sealed. The first two blowouts, which received wide publicity, resulted from failure of a connection below the blowout preventers which resulted in un-controlled flow from the wells. It has not been officially established what caused the recent blowout in March which resulted in a gas fire.
>
> Regulations have been placed in effect requiring improved hookups and connections which should reduce the chance for blowouts such as the two mentioned above.
>
> Another point which should be understood is that neither the Department of Conservation nor the people of the oil and gas industry contend that all wells drilled into a high pressure oil and gas reservoir can be completed without a risk of accidents which might result in a loss of oil or gas. There is no 100 per cent guarantee that an accident will not occur. Inasmuch as the hazard from such wells being drilled offshore is so much greater, the Department of Conservation has adopted a policy pertaining to the drilling of offshore wells in the Great Lakes

The Department of Conservation Policy states: (65)

> No lessee can assure the State of Michigan that pollution of the waters of the Great Lakes shall not result from petroleum operations. The returns from oil and gas pools in Michigan to date indicate that Michigan offshore operations have been successful on bodies of salt

> water—though not without blowouts, pollution, fires, and other hazards—recoveries have been greater than can be anticipated from Michigan submerged operations. A degree of pollution to salt waters which might be tolerated, would, in most circumstances, be damaging to our fresh waters and intolerable in many respects. Ice on the Great Lakes would provide an engineering problem heretofore not encountered nor surmounted in offshore operations elsewhere . . . Ice movements would make it mandatory that well connections and controls be placed on the lake bottom."

If the submarine pipelines carrying the crude oil and included brine were made of steel, they would be subject to corrosion by the brine, and might present a source of water pollution which would be difficult to detect and repair. If transite pipes were used (as mentioned in page 10, above), their lower mechanical strength would make them subject to damage by wave action and dragging anchors (sources of strain not found in inland oil fields).

It cannot be too strongly emphasized that any water pollution occurring in lower Lake Huron would be carried down the St. Clair River and directly into the municipal water supply of Metropolitan Detroit, as well as into the water intakes of all of the other communities situated on the St. Clair and Detroit Rivers. The contamination of the St. Clair Flats by oily wastes could prove disastrous to waterfowl and aquatic life. The damage to shore property would be of great economic significance in this densely populated area.

The Great Lakes Research Division, therefore, recommends that offshore petroleum operations be prohibited in Great Lakes Waters.

## REFERENCES


1. Thompson, A. B., *Oil Field Exploration and Development. Vol 1. Oil-Field Principles*. London Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. (p. 286), 1950.
2. Ayers, J. C., D. C. Chandler, G. H. Lauff, C. F. Powers, and E. B. Henson, *Currents and Water Masses of Lake Michigan*. Great Lakes Research Institute, Pub. No. 3, Univ. of Mich., Ann Arbor. (1958).
3. National Geographic Magazine, June, 1958, (pp. 747, 754-755).
4. Stewart, O. M., *Physics*. Grimm and Co., New York. (p. 327), 1931.
5. Milne, D., "Character of Waste Oil Emulsion". Sewage and Industrial Wastes, *22*, 326, (1950).
6. Hart, W. B., "Disposal of Petroleum Refinery Wastes". Nat. Petroleum News, Vol. 38, 1946; Petroleum Proc., Vols. 1 and 2, 1946 & 1947.
7. McKee, J. E., *Report on Oily Substances and Their Effects on the Beneficial Uses of Water*. State Water Pollution Control Board. Sacramento, California. (p. 33), 1956.
8. State Water Pollution Control Board (California), *Water Quality Criteria and Addendum*. Sacramento, California. (1952, 1954).
9. Anonymous, "Taste and Odor Producing Components in Petroleum Refinery". Environmental Health Center Activ. Rep. No. 15, 24. (1954).
10. Anonymous, "Taste and Odor Studies". Environmental Health Center Activ. Rep. No. 18, 14. (1953).
11. Anonymous, "Determination of the Nature and Sources of Objectionable Organic Substances in Water Supplies". San. Eng. Center Activ. Rep. No. 21, 20. (1953).
12. Anonymous, "Objectionable Organic Contaminants in Water". San. Eng. Center Activ. Rep. No. 25. (1955).
13. Braus, H., F. M. Middleton, and C. C. Ruchhoft, "Systematic Analysis of Organic Industrial Wastes". Anal. Chem., *24*, 1872. (1952).
14. Braus, H., F. M. Middleton, and G. Walton, "Organic Chemical Compounds in Raw and Filtered Surface Waters". Anal. Chem., *23*, 1160. (1951).
15. Middleton, F. M., and H. Braus, "Studies of Taste and Odor of Ammonia Still Wastes". Environmental Health Center Activ. Rep. No. 13, 13. (1952).
16. Middleton, F. M., H. Braus, and C. C. Ruchhoft, "Fundamental Studies of Taste and Odor in Water Supplies". Jour. Am. Water Works Assn., *44*, 538. (1952).
17. Rosen, A. A., and F. M. Middleton, "Identification of Petroleum Refinery Wastes in Surface Waters". Anal. Chem., *27*, 790. (1955).
18. Ruchhoft, C. C., "Research on Ondustrial Wastes as Related to Water Quality". Environmental Health Center Publication, Feb. 1953.

19. Ruchhoft, C. C., and M. B. Ettinger, "Tastes and Odors in Water Resulting from Industrial Wastes". Proc. 3rd Ind. Waste Conf., Purdue Univ., p. 321. (1947).

20. Ruchhoft, C. C., F. M. Middleton, H. Braus, and A. A. Rosen, "Taste and Odor Producing Components in Refinery Gravity Oil Separator Effluents". Ind. and Eng. Chem., *46,* 284. (1954).

21. Schmidt, L., and J. M. Devine, "The Disposal of Oil-Field Brines". Report of Investigations, U.S. Bureau of Mines, No. 2945. (1929).

22. Levorsen, A. I., *Geology of Petroleum.* W. H. Freeman & Co., San Francisco. (pp. 360-368), 1954.

23. Case, L. C., "Exceptional Silurian Brine near Bay City, Michigan". (Geol. Note). Bull. Amer. Assoc. Petrol. Geol., *29,* 567-70. (1945).

24. Thompson, A. B., *Oil Field Exploration and Development. Vol. 1. Oil-Field Principles.* London Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. (p. 43), 1950.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H C. McQUILLAN, Esq.

---

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 10

---

TUESDAY, MAY 10, 1960

---

Estimates 1960-61 of the Water Resources Branch
of the Department of Northern Affairs and National Resources.

---

WITNESS:

Mr. A. H. Richardson, Chief Conservation Engineer, Ontario Department of Planning and Development.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23064-9—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.
*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, May 10, 1960.
(11)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Doucett, Dumas, Fleming (*Okanagan-Revelstoke*), Godin, Granger, Hicks, Leduc, MacRae, Martel, Martin (*Timmins*), McFarlane, McQuillan, Mitchell, Murphy, Payne, Simpson, Slogan, and Stearns —18.

*In attendance:* Mr. A. H. Richardson, Chief Conservation Engineer, Ontario Department of Planning and Development; and *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; and J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

Mr. Richardson was introduced and he made an extensive statement on flood control and water conservation as related to the province of Ontario and was questioned thereon.

The questioning completed, the Chairman announced that Dr. J. D. Frame, of the Cities Service Research and Development Company, of New York would appear before the Committee on Monday, May 16, to discuss water pollution problems in the United States, and that Mr. Hull, President of Cities Services Oil Company of Toronto would also be present.

At 10.40 a.m., the Committee adjourned until 11.00 a.m. Monday, May 16.

M. Slack,
*Clerk of the Committee.*



23064-9—1½

# EVIDENCE

TUESDAY, May 10, 1960.

The CHAIRMAN: Gentlemen, we have a quorum. We have with us today Mr. Richardson, chief of the conservation branch of the Ontario department of planning and development. He will speak to us on the question of flood control and water conservation in Ontario, and other related problems. Therefore I invite Mr. Richardson to carry on.

Mr. A. H. RICHARDSON (*Chief Conservation Engineer, Department of Planning and Development, Ontario Government*): Mr. Chairman, and gentlemen: first of all I would like to thank your chairman for inviting me to attend this meeting, because I consider it an honour to come from Ontario to discuss these matters with members of the federal government.

The work which I am going to discuss of course has entirely to do with Ontario in relation to flood control and water conservation, and most of the work which I shall mention is being carried on in southern Ontario.

Now, you may wonder why we are interested in flooding in Ontario. But coming down on the train I met a friend, and I told him where I was going. He said: "You have picked out a pretty good time, with the reports of floods around Ontario as they are at the present time."

There has been a great deal of flooding in Ontario almost from the first settlement here. I do not want to burden you with the history—a complete history of flooding in this province, but we have gone into the record and I would like just to mention a few interesting points, to show that flooding has been common in this province, and more than that, that flooding has occurred in every month of the year.

We sometimes think of floods occurring only in the spring. Actually they occur every month of the year.

The first record we have of a flood is in 1680. The next one was in 1798, when the Thames river flooded just south of London, and it was reported that the river rose 20 to 25 feet.

One interesting reference to floods in Ontario was during the war of 1812 to 1814, when a brigade of Kentucky riflemen riding through Ontario came to the Thames river and forded it—on horseback, of course; but when they got to the Grand river, it was so high that they were turned back.

Then there was another severe flood in 1850; and it is interesting to note that the reading of the stage of the river at Weston in 1850, on the Humber, was just one foot lower than the stage of the river in hurricane Hazel, which I shall mention briefly.

There was another interesting flood which I am sure you gentlemen will be glad to hear about. It occurred in 1878, and it was called the Mowat flood. Flooding across Ontario was so severe that election day had to be postponed. Some of the people could not get out to vote. And I venture to mention this observation, that if floods interfere with election days, then they are becoming very important.

Mr. MARTIN (*Timmins*): Whom would they blame for that?

Mr. RICHARDSON: I am just a civil servant, and I would not even know who was running.

There was another severe flood in Belleville which lasted for 58 days, and of course the all-time high for a flood was hurricane Hazel which

occurred in October of 1954. That was the severest flood on record in central Ontario. We had a rainfall in the Toronto region at that time of as much as 12 inches in 48 hours. That was an exceptionally high rainfall. It is estimated that 200 million tons of water were dumped on the Toronto region.

The flow was 45,000 cubic feet per second, which is about equal to the amount of water used to run the generators at the hydro plant at Queenston. There were 81 lives lost, and the damage as far as it could be estimated, was $20 million. It is almost impossible to estimate the total damage which occurred following that flood.

A great many homes were destroyed. In connection with the repayment for damages to homes, you probably will recall that the federal government and the Ontario government reimbursed a great number of home owners to the extent of about $3 million. This was shared fifty-fifty by the two governments.

Now, of course, there was damage to the channel, the utilities, and to many other structures on the river. This damage was severe, which is usually the case when you have a bad flood. The whole city was paralyzed for a number of days.

Flood control, of course, is something which we have to try to take care of; but that is not the whole story, because, linked with flood control is the problem of water conservation.

If you look at the rivers in southern Ontario you will find that for the most part they have too much water in the spring, and sometimes very, very little in the summer. So there is the problem of holding back and conserving that water for use later on in the year.

We have made several studies of the amount of water which is wasted in the province. I do not want to burden you with too many facts, but just to indicate what I mean I shall mention two small studies which we did. One was in connection with the tobacco growing land in Norfolk county. We know how much water groups of farmers in that area need for their tobacco growing. We figured from the gauges on the river the amount of water which went down in March, 1946, and it worked out that if that surplus water, that is, over and above the normal flow of the river, could have been saved by reservoirs or some other means, it would have supplied these tobacco growers for 13 years.

Another example is the city of Brantford, which takes its water from the Grand river. The Grand, of course, in the past has been noted for severe flooding. And based on the consumption of water by the city in 1948, when the flows were excessive, the amount of water which passed the river during 15 days in March, 1948, should have been enough to supply that city for 64 years. It is the excessive waste of water in springtime, when we do not need it, and the holding it for summer flow and better use in the summer which is part of our work.

The beginning of water conservation in Ontario in relation to the municipalities—and after all it is a partnership program which we have in Ontario —commenced with the Grand River Commission Act in 1938.

This act was established for water conservation and flood control on the Grand river only. The act covered just that one watershed, and it applied only to eight urban municipalities, such cities as Brantford, Paris, Preston, Waterloo, Kitchener, and so on.

After the war there was a great deal of interest in general conservation and in water control. In 1946 the Conservation Authorities Act was passed, which had some of the sections of the old Grand River Commission Act in it; but the main difference between those acts is that the Grand River Commission Act included only eight urban municipalities, whereas the Conservation

Authorities Act includes all municipalities in the watershed, townships, villages, towns, cities and everything but counties.

That legislation could be made operative simply by the petition of two municipalities asking for the formation of an authority, or consideration for an authority to the Ontario government. The machinery is quite simple. Two municipalities in the watershed must petition the government, and if two-thirds of them attend and come to the meeting and pass a favourable resolution by a two-thirds vote, then the government passes an order-in-council establishing this authority, and they elect their officers and carry on. They are on their own except, of course, that they get a great deal of assistance and guidance from the conservation branch of this department.

In the Conservation Authorities Act, all types of conservation work can be carried on, such as reforestation, land use, fish, wild life, and recreation; but I do not intend to touch on any of them this morning, because I want to confine my remarks entirely to the problem of water.

You might be interested to know that the authorities which are displayed on this map behind me in colour—there are 27 authorities, plus the Grand River Commission; and of them the largest one is the Grand, starting at lake Erie and running up almost to the village of Dundalk in Grey county.

Some of them are quite small, but there is no limit to the size of these authorities as long as they have fulfilled the requirements of the act. Some of them have a membership of only six municipalities. The Grand, for example, has a membership of seven municipalities.

There are 27 of these authorities, with 457 municipalities as members, covering 16,000 square miles, and the membership, because some municipalities have more than one member, numbers 527. When these authorities are established the conservation branch of the department of planning and development undertakes investigative studies. The studies I wish to mention are those which apply to water; that is, studies for water conservation, flood control, channel improvements, and other types of water projects.

We have this scheme, or series of schemes and plans divided into four groups. The first group includes those which have been completed or are under way. They amount to about \$20 million. We have another group, those ready for construction, which amounts to another \$30 million. We have a third group, where we are investigating further, which represents \$71 million. Then we have a fourth group, consisting of possible schemes which might be undertaken in the future, representing another \$15 million; or a total of \$135 million.

The work of the authorities with regard to these projects covers a great variety of subjects. As I have mentioned, they consist of large dams, little dams, channel improvements, farm ponds, community ponds, water spreading, stream bank erosion, and so on. Including the big projects we list 65 which have been undertaken. On all these projects—as a matter of fact, in most of the work of the authorities—the Ontario government has been making a contribution of 50 per cent, up to \$5 million. But if you look over the list of projects which have been carried out, most of the projects are in the lower brackets. They run anywhere from a few thousand dollars to \$50,000, or \$100,000, but none of them goes over \$1 million. There are only possibly three which are up in that bracket. So when we get above \$1 million we find it is difficult for the municipalities to carry on their projects, to which they must contribute themselves large sums of money.

Now the four dams which are the largest—and which I would like to mention very briefly, because they are the projects, the only projects to which the federal government has made contributions—are these: There are three dams on the Grand river, which were built under the original Grand River Commission Act, which I mentioned at the beginning; and there is one on the

Thames, just above the city of London. I say there are four, although one of these dams is quite small and sometimes is considered a part of one of the others.

In order of construction these dams are: The Shand dam, above Fergus, on the Grand river, which was completed in 1942, during the war, of course, at a cost of $2,056,000; the Luther Marsh dam, which is a very interesting type of water control project, because it occupies land which is one of the largest swamps in the province, which has been farmed to a certain extent in the past, burnt over and drained, and eventually has been returned to its original use, so there are 5,000 acres of marshland in this area, which is now a reservoir which feeds into the Grand river and stores 10,000 acre-feet.

The next dam which was built was the Fanshawe on the Thames, about six miles from London, and it was built to protect the city of London from flooding—or partially to protect it. It cost $4,799,000.

The last one, which is just being completed, and which has been in operation for the last two years, is the Conestogo on the Grand, which is very similar to the first one which was built in 1942. It will cost, we expect $4,900,000.

To the construction of these four dams the federal government contributed 37½ per cent, the Ontario government 37½ per cent, and the benefiting municipalities, through the authorities, 25 per cent.

It has been the practice, in carrying out work with the authorities, that in everything they do—although they have their choice in this—in the way of land use or reforestation, parks and so on, they divide the cost on a population basis throughout the member municipalities. But when it comes to flood control and water conservation on a large scale—such as the work on the Grand at the Fanshawe dam, for the city of London—the act says the municipalities that benefit must pay the authority's share. The authority is the body deciding who those municipalities are.

Mr. Chairman, that brings me just about to end of my story. I can give you additional facts about these things I have been discussing, but I think, briefly, that covers the work of flood control and water conservation as carried on by the conservation authorities in southern Ontario and the Grand River commission.

The CHAIRMAN: Thank you, Mr. Richardson. Are there any questions that anybody would care to ask?

Mr. DUMAS: Mr. Richardson, does the Grand river project cover the whole basin of the Grand river.

Mr. RICHARDSON: The whole watershed.

Mr. STEARNS: I would like to go a little bit further, Mr. Richardson. What is the length of the Grand river, approximately?

Mr. RICHARDSON: It must be 135 to 140 miles from Lake Erie to the village of Dundalk.

Mr. STEARNS: What about the watershed?

Mr. RICHARDSON: It is about 2,800 square miles.

Mr. STEARNS: These three dams, you call one the Shand?

Mr. RICHARDSON: The Shand.

Mr. STEARNS: Then the next?

Mr. RICHARDSON: The Luther Marsh.

Mr. STEARNS: Who designs these dams?

Mr. RICHARDSON: And then there is the Conestogo.

Mr. STEARNS: Oh yes, that is the third one?

Mr. RICHARDSON: Yes.

Mr. STEARNS: Are these designed by provincial engineers?

Mr. RICHARDSON: No, the arrangements are, when an authority—or, in this case, the commission—wants to proceed with a project they must acquire their own engineers. For that particular type of work the province contributes 75 per cent of the engineering cost, because we find in some cases an authority might decide or wish to go on with the same type of work and there is no way of calculating what it is going to cost until they have an engineering study made, and sometimes they find it is beyond their ability to pay.

We felt it would be fair to help them with the engineering; so the government, up to the present, has paid 75 per cent of the engineering cost. That same engineer is in charge of the construction. Finally, the engineer for those three dams was H. G. Acres and Company of Niagara Falls.

Mr. STEARNS: If the federal government participate in some of these works, I assume they approve the plans of the engineers before they pay any money?

Mr. RICHARDSON: Very definitely.

Mr. STEARNS: Are all these dams concrete dams?

Mr. RICHARDSON: No, they are earth dams, with some concrete construction, concrete outlets.

Mr. MURPHY: Mr. Richardson, the Fanshawe project above London—that is the one that interests me a great deal, because you mentioned they had overcome the flooding in the city of London. Since that project was constructed has there been any flooding in the down-river towns or cities?

Mr. RICHARDSON: That is, in the lower part?

Mr. MURPHY: Say, at Thamesville and Chatham. Are they flooded at all now?

Mr. RICHARDSON: Yes, they are flooded this year and are flooded, more or less, quite often. While there is an authority on the Thames, it starts at London and goes north.

Mr. MURPHY: The point I was getting at was that the Fanshawe project above London only protects London, as I understood you to say?

Mr. RICHARDSON: That is right. Well, it does cut off the peak of the flows down the river. But everything you build up the river is going to help those down below.

Mr. MURPHY: Has there been any flooding since the Fanshawe dam was constructed—spring flooding?

Mr. RICHARDSON: Down below?

Mr. MURPHY: In Chatham, say?

Mr. RICHARDSON: Yes, this year.

Mr. MURPHY: In the basements of the stores, and so on?

Mr. RICHARDSON: I do not think it was as bad this year as it has been, but they do get flooding.

I should point out, sir, while I said the Fanshawe dam was built to protect London, we do not guarantee the Fanshawe dam is going to protect London entirely.

Mr. MURPHY: I understand that.

Mr. RICHARDSON: There is a program for the upper Thames which includes the building of several dams.

Mr. MURPHY: You mentioned this year, but were there any years? Of course, that is where I live, that area. When I was a youngster, the Thames river used to overflow and would cover all the bottom lands of the farms in that area, in Kent county. Does that happen now?

Mr. RICHARDSON: I do not think it happens as much. But it could happen. I think it could happen, again for this reason, that there is a long stretch of country—what is it from London down to the lake: it must be nearly 100 miles, is it not?

Mr. MURPHY: It is more than that.

Mr. RICHARDSON: Well, there is the long stretch of the Thames watershed from which a lot of water comes in from that area below the Fanshawe dam. So it is possible that if you had a severe summer storm, or something like that, on the lower Thames and not on the upper Thames, you might get flooding in Chatham and around that area—probably not as severe as in the spring—regardless of the presence of the Fanshawe dam.

Mr. MURPHY: I am referring to the area above Chatham.

Mr. RICHARDSON: You might be interested in knowing that they have been working on the establishing of an authority there. Last year we had a meeting, and it was defeated. I had correspondence with them just the other day. They wanted to have another meeting. I think they will get it eventually.

Mr. MURPHY: What is that project? What area will it affect?

Mr. RICHARDSON: If they come in, they will include the whole Thames river.

Mr. MURPHY: From London, down?

Mr. RICHARDSON: No; there will be the present authority from London up.

Mr. MURPHY: I mean, from London down.

Mr. RICHARDSON: It will be the whole area, right down to the lake.

Mr. MURPHY: That is over 150 miles?

Mr. RICHARDSON: Yes.

Mr. MURPHY: How many municipalities met at the last meeting? I think they met at Dresden, did they not?

Mr. RICHARDSON: No, they met at Thamesville, I think. I was there, but I am not quite sure.

Mr. MURPHY: You do not know how many municipalities were represented?

Mr. RICHARDSON: I would just have to make a guess. I would think there would be about 28 or 30, in the lower Thames.

Mr. MURPHY: What was the project that was envisaged—a dam where?

Mr. RICHARDSON: They were interested particularly in stopping flooding at Chatham and the other towns down the river, and they were particularly interested in more diking. Also, they have had trouble over the years in keeping the ice out of the river in the spring. In fact, from time to time they have employed an ice-breaker to come up the river and open the channels. It contributes to flooding if the ice jams up.

Mr. MURPHY: I think the committee would be interested in knowing a little more about these projects, because what I had in mind regarding the farm areas was that these spring floods do take a good deal of the top soil, the best part of the land, into the stream and down into the lake.

This flood control idea would prevent that, would it not?

Mr. RICHARDSON: The big dams do not have too much effect on the run-off from the farmland.

Mr. MURPHY: I am speaking about when the river overflows in the spring.

Mr. RICHARDSON: Yes.

Mr. MURPHY: Some farms are half covered.

Mr. RICHARDSON: Very much so.

Mr. MURPHY: And the top soil of those farms goes into the river and down through to the lake.

Mr. RICHARDSON: It not only robs the farm; it silts up the river and piles the silting of the lake.

Mr. MURPHY: I am referring to the flooding of farmland from London, east, on the Thames river.

Mr. RICHARDSON: That is the most extreme west end of the province—Sarnia. This is lake Huron here. It is this reddish area. That is an interesting authority, because it is almost entirely rural. There are three small places. There is Exeter, which is under 3,000; there is Park Hill, and Arkona. They are all little places.

The remainder of the authority is all rural, and right now they very badly need some flood control. There is one project with which they are hoping to proceed. Frankly, they are asking the federal government for this $37\frac{1}{2}$ per cent formula; but in this particular case it is largely for the protection of farmland; the type of land you are talking about.

Mr. MURPHY: What area does that cover, in acreage, do you know?

Mr. RICHARDSON: Well, I do not know exactly; but it is several thousand acres.

Mr. MURPHY: It would be over 100,000 acres, would it not?

Mr. RICHARDSON: No, I do not think it is that much. It is approaching the Thetford flats, where they grow the celery; the celery flats.

Mr. MURPHY: It is in my riding.

Mr. RICHARDSON: Then you know Dr. Hagmyer's property?

Mr. MURPHY: Yes. There are several thousand acres in there. That is bottom land. It has about 10 or 12 feet of muck.

Mr. RICHARDSON: That much is not flooded, though, is it?

Mr. MURPHY: No, I would not think so.

Mr. FLEMING (*Okanagan-Revelstoke*): Did I understand that when these authorities are established, flood control is what is being sought; but also they are an integrated authority and a great many other aspects of conservation come under the jurisdiction of the authority? For instance, wildlife, fish life, recreation, and so on?

Mr. RICHARDSON: Yes.

Mr. FLEMING (*Okanagan-Revelstoke*): That is all part of this same authority, is it?

Mr. RICHARDSON: Yes, I did not mean to indicate that flood control is the only reason for establishing the authorities. Actually, because flood control is the most expensive project, more money is spent on that. But some of these authorities do not carry out any flood control at all. For example, the authority at Ganaraska, covering the area which goes into Lake Ontario at Port Hope, is a small authority and their program is entirely reforestation. They have been running about 10 years now and they have about 7,000 acres of hilly country to the north where the river rises. They have this planted with trees. They are proceeding with a program of 20,000 acres.

As I passed over the river last night—and I noticed in the paper—it is on the rampage, and I think you can readily understand that they need some flood control there. But they have chosen to start with reforestation. Also, in the metropolitan Toronto region a very pretentious flood control scheme has been submitted to the federal government. It came to Ottawa recently. That scheme would cost $34 million. Most of their interest up to this point has been to establish parks. They have a chain of very fine parks across the Toronto region—not in the city, but out in the country.

Mr. MARTIN (*Timmins*): Mr. Richardson, you mentioned that one authority has dealt so far mostly in reforestation, as against direct flood control. I am not familiar with the country. I do not even know if it is feasible or possible; but what study and what efforts have gone on to date to combine reforestation and flood control: In other words, as a secondary measure to the direct flood control of building dams?

Mr. RICHARDSON: I think the people on the Ganaraska river would agree that their reforestation program is supplementary to flood control.

We sometimes hear that planting trees and reforestation will stop floods. It will, under certain conditions; but in a good many other conditions it will not.

For example, when I was reviewing the flood position in Ontario—take the flood of 1850 on the Humber; the whole area was covered with trees. There comes a time when the whole area can be saturated. On the Ganaraska they are doing what you suggest; they are choosing the lesser of two evils. They have not got enough money to build dams. They know all this land has to be reforested. It will help to control the run-off, and that is where they propose to start.

Mr. MARTIN (*Timmins*): I notice in the newspapers that there is considerable flooding up in the Timmins area at the present time. One of the reasons for that is because of the trees, which protected the land from the snow, and when the snow melted very quickly it caused the flooding there. If there had not been so much snow there, it would have gone a little more easily than it has.

Mr. RICHARDSON: I think there is also the fact that the hydro dams are there. I am not trying to blame the hydro.

Mr. MARTIN (*Timmins*): We hope they are still there!

Mr. RICHARDSON: Yes. But the controlling of these dams may have some effect: I do not know. It is a difficult thing to control big dams where you are trying to store water. That is one thing I admit when I mention these dams on the Grand: it is a very important point.

The dams on the Grand serve two purposes. They are completely empty in the autumn, so that they will be ready to take the flood waters of the spring. Then the trick is to decide when the floods are at their peak, or when they are just over and the engineers can hold the dams full. Then during the summer months that water is turned down into the Grand river to increase the summer flow. That is a very important function of those two dams.

It is not the way the dam on the Fanshawe operates. It is used strictly as flood control. When the floods are over, the flood section of the dam is completely empty. And they have left a permanent pond in the bottom which forms a very attractive lake for recreation.

Mr. GODIN: I understand that most of these smaller authorities do not have the federal scheme involved in it, and possibly only the major ones do.

Could you tell the committee just what formula is used to have it step into the second scheme where the federal government pays 37½ per cent? Is it because of the cost of the possible projects, or the drastic conditions, or what?

Mr. RICHARDSON: I do not know that I can tell you that. If you turn to the Canada Water Conservation Act, there is one section there, section 5, subsection (5):

> Contributions under this act shall be limited to projects that in the opinion of the Governor in Council are of a major character.

It is that phrase that has to be defined before I could answer your question. The indications are—and rightly so—that it must be the larger dams. If you

examine the costs of these dams which I have mentioned on the Grand and the Thames, and take into consideration that the Shand dam was started in 1938 and cost $2 million—which would perhaps be close to $5 million now—and with the Fanshawe and the Conestogo we are in the $5 million bracket, it would indicate a project around $5 million is the type of scheme on which we should apply to the federal government for assistance.

Mr. GODIN: Five million dollars? I thought you made a reference to the Sarnia area, where the project would involve only rural territory, and they were expecting the 37½ per cent from the federal government?

Mr. RICHARDSON: You cannot stop these authorities from asking, you know. Some of them have asked for assistance on smaller amounts than that.

Mr. MURPHY: Mr. Chairman, I think there is one important point that we have not dealt with. Do these projects affect the quality of the water in the various areas? Do they affect the quality of the water that is required for, say, cities—we will say, Brantford, or any other place?

Mr. RICHARDSON: You mean, the lake at Conestogo, for example? Brantford, of course, is on the Grand. I do not think it affects the water too much. Dr. Berry could answer that. But this water is the same river water that is passing through the reservoir—

Mr. MURPHY: But you do not have the low water that you used to have at some periods of the year, do you?

Mr. RICHARDSON: If you mean the quality of the water down the river at summer time—

Mr. MURPHY: That is right.

Mr. RICHARDSON: That is the purpose of the summer flow from these two dams. That is one of the chief purposes, to keep the river replenished and keep it as sweet and clean as you can.

Mr. MURPHY: You mentioned the Norfolk area. That is over on the Lake Erie area.

Mr. RICHARDSON: That is right.

Mr. MURPHY: You said there is enough water wasted in one season to supply the tobacco farmers for 13 years. What has been done about that?

Mr. RICHARDSON: The authority, which is the Big Creek region, which goes through Norfolk, was instrumental in having the act amended to permit the authority to regulate the use of water through streams. When they did that it was a very dry year. They got the regulations passed, and then they ran into a wet year and they did not follow it up. And the next year was fairly wet. So actually, while they have the power to do this, they have not implemented it as yet. But if they want to, they can regulate the use of water.

Mr. MURPHY: You do not have anything to do with the lakes, do you?

Mr. RICHARDSON: No.

Mr. FLEMING (*Okanagan-Revelstoke*): Mr. Chairman, I have a question arising out of that. Does irrigation come within the ambit of these authorities? Do they operate irrigation systems where required, or has that arisen?

Mr. RICHARDSON: The only way irrigation would come into the authorities' work is—as I have mentioned—that they might regulate the amount of water which a tobacco farmer would use; or they might assist them in building ponds for irrigation. That is one of the good programs of the authorities, subsidizing the building of farm ponds.

Mr. FLEMING (*Okanagan-Revelstoke*): But there are no large-scale irrigation systems?

Mr. RICHARDSON: No.

Mr. FLEMING (*Okanagan-Revelstoke*): I wonder if you could answer this question, Mr. Richardson? Is this system such as has been developed in Ontario unique in Canada, or are there other provinces, to your knowledge, that have similar systems?

Mr. RICHARDSON: I understand one of the western provinces has a program something like it. I do not think it is just the same.

The CHAIRMAN: Which province would that be, Mr. Richardson—do you know?

Mr. RICHARDSON: Is it Saskatchewan?

The CHAIRMAN: I do not know.

Mr. RICHARDSON: I have not heard too much about it.

Mr. FLEMING (*Okanagan-Revelstoke*): It is not widespread in the country, then, this system of approaching the problem of flood control?

Mr. RICHARDSON: No.

Mr. HICKS: I understood you to say, Mr. Richardson, that there was quite a large area of swamp, wet land, muskeg land, redeemed at one time, or reclaimed at one time. This went on for a year or two, and then later the water was turned back into it and it was turned back into wild land again; is that correct?

Mr. RICHARDSON: No. It was dammed up and filled with water. There is far more water in it now than there was when it was just a swamp. But the history of several of the swamps in Ontario is that they were drained for agriculture. Some of them have been a success; some have not. The trees were cut from them.

That was the case in the Luther Marsh, which was about 5,000 acres. Eventually the whole area was purchased and the drains and the outlets around the periphery of the marsh were choked off and one main dam put in. It only cost $240,000, which is a small amount for a dam. That gives you a big lake of approximately a little less than 5,000 acres of very shallow water. But even at that, it gives you 10,000 acre feet, which is a lot of water.

Mr. HICKS: At one time, either before that or during the process, some of that land was owned by private individuals?

Mr. RICHARDSON: It was all bought from private individuals.

Mr. HICKS: Who set the rate, then, to pay the owners?

Mr. RICHARDSON: That was done by a committee of local farmers.

Mr. HICKS: Local men?

Mr. RICHARDSON: Local men, in that case. They tried to do that. They got people who lived in the community and had a knowledge of the value of the farmland, and I think there were 92 parcels altogether, for example, purchased on the Conestogo property.

That was all done by the farmers. The interesting thing is that of those 92 parcels there were only about three that went to arbitration.

Mr. HICKS: Approximately, what was the rate per acre on that, do you recall?

Mr. RICHARDSON: I would say, on the average, $200 an acre.

Mr. HICKS: Thank you.

Mr. RICHARDSON: Not the marsh, mind you. Did you mean the price on the marsh?

Mr. HICKS: No; in the area.

Mr. RICHARDSON: That would be farmland.

Mr. STEARNS: How about the marshland?

Mr. RICHARDSON: I do not remember what that was. It would be much less.

Mr. DUMAS: Mr. Richardson, did you say that the total cost of the projects completed today by the 27 authorities in Ontario was $20 million, and that you have projects estimated at $115 million?

Mr. RICHARDSON: Yes; it is $19 million, close to $20 million.

Mr. DUMAS: Spent to date?

Mr. RICHARDSON: Yes.

Mr. DUMAS: And you have projects estimated at $115 million?

Mr. RICHARDSON: Well, that is into the future, 30 or 40 years.

The CHAIRMAN: Mr. Richardson, were any of these authorities created with the primary objective of elimination or control of pollution?

Mr. RICHARDSON: When the Authorities' Act was framed, pollution was mentioned; but we have always considered—and the authorities too—that pollution was a problem for the Department of Health and Welfare, which it was at that time, which has now been transferred to the Ontario water resources commission. So the authorities do not take any active part in pollution, except to protest when they find it.

The CHAIRMAN: Are there any further questions, gentlemen?

Mr. MURPHY: I must take exception to one statement that Mr. Richardson made; his historical reference to the 1812 war. I think you will find that the army crossed the river Thames about 10 miles from Chatham—

An hon. MEMBER: Were you there?

Mr. RICHARDSON: They crossed the Thames but they were stopped at the Grand.

Mr. MURPHY: But the battle was at Moraviantown, and I thought you said they could not cross the river.

Mr. RICHARDSON: No; this was a raiding party that was making for a fort at Burlington at that time. They crossed the Thames by swimming the river. When they got to the Grand, the water was so high that they were turned back. That is what my historian tells me.

The CHAIRMAN: Thank you, Mr. Richardson; we appreciate very much your coming here. If anybody wishes a copy of the act, Mr. Richardson says that he has some copies of the provincial act concerning this matter.

Mr. MURPHY: I would like to have a copy, Mr. Chairman. Mr. Richardson, your department is not concerned with pipelines either?

Mr. RICHARDSON: No; that is water resources. We are interested in saving water and using it for the areas.

The CHAIRMAN: Thank you, Mr. Richardson. I am sure you are pleased to get away with a short meeting today. On Monday next, gentlemen, at 11.00 a.m., we have with us Dr. J. B. Frame, as I have outlined to you previously, of the Cities Service Research and Development Company, New York City, on the question of water pollution problems in the United States. I am sure he will give us a great deal of information concerning what we may expect in problems in Canada in the future.

Mr. Hull will also be here. He is president of the Cities Service Oil Company of Toronto, and he will be talking about some of the problems that they have in Canada. That being all, we will adjourn.

Mr. MURPHY: Mr. Chairman, when do you intend to take up the Navigable Waters Protection Act?

The CHAIRMAN: I cannot tell you right at the moment.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 11

---

MONDAY, MAY 16, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESSES:

Mr. R. J. Hull, President, Cities Service Oil Co. Ltd., Toronto; and Dr. John D. Frame, Director of Waste Treatment, Cities Service Research and Development Co., New York City.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23062-3—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, May 16, 1960.
(12)

The Standing Committee on Mines, Forests and Waters met at 11.00 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present*: Messrs. Doucett, Fleming (*Okanagan-Revelstoke*), Gundlock, Hicks, Kindt, MacRae, McFarlane, McGregor, McQuillan, Mitchell, Payne, Robichaud, and Simpson. (13)

*In attendance*: Mr. R. J. Hull, President, Cities Service, Ltd., Toronto, and Dr. John D. Frame, Director of Waste Treatment, Cities Service Research and Development Co., New York City. *From the Department of Northern Affairs and National Resources*: Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; and J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman read a letter from Mr. J. R. Menzies of the Department of National Health and Welfare, who appeared before the Committee on May 9th, correcting evidence with reference to seaway treatment in the City of Saskatoon.

*Agreed,*—That an answer to a question asked by Mr. Payne on May 3rd with respect to the Fraser River Board be printed as an appendix to this day's evidence (*See Appendix "A"*).

The Chairman referred to a letter he received from the Honourable Alvin Hamilton, Minister of Northern Affairs and National Resources, dated May 9, 1960, calling attention to the Fifth World Forestry Congress to be held in Seattle, Washington, from August 29th to September 10, 1960.

The Chairman introduced Messrs. Hull and Frame and then called on Mr. Hull.

Mr. Hull made a statement on his company's experience with water conservation and the prevention of water pollution, and was questioned thereon.

Dr. Frame made a statement on the technical aspect of waste disposal facilities for refineries in the United States and Canada as related to water conservation.

Questioning being concluded, the Chairman thanked Messrs. Hull and Frame for their interesting presentation.

At 12.45 p.m., the Committee adjourned until 9.30 a.m. Tuesday, May 17.

M. Slack,
*Clerk of the Committee.*



23062-3—1½

## EVIDENCE

Monday, May 16, 1960.

The Chairman: Gentlemen, we have a quorum. Please come to order.

There are a few matters I want to bring before the committee before I introduce the witnesses we have today.

You will remember that we had Mr. Menzies, chief of the public health engineering division of the Department of National Health and Welfare, before us on May 9. He has asked me to bring to the attention of the committee this letter, which reads as follows:

Department of National
Health and Welfare
Environmental Health Centre,
Room 318, 45 Spencer Street,
Ottawa, Ont., May 10, 1960.

Mr. H. C. McQuillan, M.P.,
Chairman,
The Committee on Mines, Forests & Waters,
House of Commons, Ottawa,
Ontario.

Dear Mr. McQuillan:—

Confirming our conversation by telephone today, I wish to advise you and the members of your committee that my reference to the City of Saskatoon at the committee hearing yesterday, May 9, was poorly chosen. You will recall that I mentioned it as a location where raw sewage is being discharged to the south Saskatchewan river without treatment and that it was thought that treatment works were not required because of the use made of the river downstream from Saskatoon.

By today's mail I learned that a sewage treatment plant is presently being designed for Saskatoon. Would you please bring this correction to the attention of your committee.

Yours very truly,

(Signed) J. R. Menzies,

J. R. Menzies, P. Eng.,
Chief, Public Health
Engineering Division.

Then, Mr. Payne asked some questions of Mr. Patterson with respect to the Fraser river board. Mr. Patterson has furnished some of the answers to those questions. Is it the wish of the committee that they be printed as an appendix to today's record?

Agreed.

(*See Appendix A*).

Mr. Payne: Are they complete?

The Chairman: There are still some to come.

Mr. PAYNE: They will follow?

The CHAIRMAN: Yes.

I also have a letter from the minister calling my attention to the fact that the fifth world forestry congress will be held in Seattle, Washington, U.S.A., from August 29 to September 10 of this year, and if anyone is interested he may get further information from Dr. J. D. B. Harrison, chairman of the Canadian national committee of the congress, and director of the forestry branch of the Department of Northern Affairs and National Resources.

I think that is all the business I have to bring to your attention.

Now I would like to introduce to you our witnesses today. First I have on my right Mr. R. J. Hull, president of the Cities Service Oil Company Limited.

Mr. Hull makes his headquarters in Toronto as president of the Canadian section of Cities Service Oil Company Limited. We also have with us Dr. J. D. Frame, director of waste treatment for the Cities Service Oil Company Limited, New York.

We have asked him to come here to discuss their work in the field of anti-pollution. Mr. Hull will present the brief, copies of which you already have, and later Dr. Frame will deal generally with the subject. Both gentlemen will be prepared to answer any questions you may wish to ask them. Will you kindly proceed?

Mr. R. J. HULL (*President, Cities Service Oil Company Limited*): Mr. Chairman, members of the House of Commons committee on mines, forests and waters: Cities Service Oil Company, Limited was most appreciative of your invitation to appear before this committee.

In that invitation, we were asked to outline to you our company's experience with water conservation, and in particular:

—our motivation in approaching this problem as we have;
—our method;
—and the success of our measures.

I will, therefore, use those three points as the boundaries for my discussion before you this morning. Later, my associate, Dr. J. D. Frame, of the Cities Service Research and Development Company in New York will appear before you. Dr. Frame has worked closely with us here in Canada throughout the development of this project and will, as requested, present to you several of the semi-technical aspects of our experience and case history.

*Our Motivation:*

First of all, in opening the subject of our motivation, it probably escaped you that a moment ago I used the phrase "water conservation" rather than the traditional one, "the water pollution problem". I do this simply because it is a positive term. Cities Service's approach has been a positive one and I might suggest that what has motivated us may be found in the slight shades of difference found in this terminology. Conservation, according to our philosophy, is simply a question of good industrial housekeeping. It requires the same ingredients as a well-managed, tidy home—time, money and energy. The results are the same, as well: happy neighbours, the respect and praise of the community and a personal sense of self-respect and pride.

These were the same principles that motivated Cities Service in the planning of the many good industrial housekeeping measures, including water conservation, in its new $27 million Trafalgar refinery.

First of all, we considered in depth the question of happy neighbours. Oil refineries and perhaps any heavy industry are not normally regarded as popular neighbours. And at Trafalgar township, near Toronto, we were moving

into an area that until a short time ago was primarily agricultural or residential and had seen little industrial development. We were, to draw another parallel, in the position an individual might find himself in when planning to build an attractive but ultra modern split-level house in an area of traditional English tudor homes. Some of our future neighbours were frankly dismayed, troubled and a few openly hostile. We had anticipated this natural anxiety and tailored our plans accordingly well in advance, from the day plans first went to the drawing board.

We appreciated that our neighbours' concern would be based on sight, sound, smell and pollution. Your interest is in water pollution and so I shall confine my testimony to this point. However, there were many other considerations at the refinery and to cover them all we spent $1.00 out of every $8.00, $3 million in all, on good housekeeping measures.

Next, the question of the *respect and praise of the community,* which is another way of saying "public relations". Cities Service recognizes that its public relations are a most important factor on its balance sheet—commercially we can only prosper and grow if we are well and favourably known, have the goodwill of our customers and present them with the reasons why they should support our company via purchases of our products. In this sense, our community is our marketing area. —For this reason, our sense of public relations motivated our decision to expend major sums of time, money and energy on water conservation. We reasoned, and I believe most correctly, that as a growing company involved as we are in a multi-million dollar expansion program, we could benefit from good deeds. It is my personal opinion that more industries would benefit from investing their funds in actual good works than by spending money to merely tell the public how good they are.

Lastly, we were motivated by what I termed a personal sense of self-respect. I do not propose to sermonize on this altruistic plane. It is, I believe, sufficient to state that, on a long-term basis, the successful industries are the ones with a corporate conscience. As a company, Cities Service has a strong sense of conscience and a high degree of pride in its role as one of the largest oil companies in the world. This was our company's final motivating factor in its decision to undertake an advanced water conservation program.

*Our Methods:*

Against this background of interest, Cities Service designed a broad program of water conservation. One that was intended to be carried even outside the gates of the new Trafalgar refinery.

Many months before the first sod was turned for our refinery, we commenced design of our water treatment plant. Our objective was to engineer a system that would purify our liquid industrial waste into crystal clear water that was eminently fit to drink before it was returned to Lake Ontario.

At the same time, we were well aware of the fact that it is demonstrably easier and less expensive to install a plant for the treatment of effluents in a brand new operation than it is to try and incorporate this sort of system in an operation that has been active for some considerable period of time.

It is much more efficient to be able to co-ordinate a treatment process with a manufacturing process when both are in the planning board stage. Herein lies one of the most difficult problems in dealing with industrial wastes. Many of Canada's industries were established at a time when the problem of pollution barely existed due to the fact that there were fewer industries and a much smaller population to contribute towards it. A tremendous surge forward in Canada's population and economy has brought us face to face with a problem which was menial before. We understand that there are many established industries which simply cannot economically afford to install effluent treatment

systems until adequate research has been done to create a process which can bring it within their financial means. This is one of the problems which must be faced and overcome.

Let me stress Mr. Chairman that it is no easy task to treat the waste materials which come out of an industrial complex. This is especially true in our industry.

I should draw for you a mental picture of what liquid waste from the average oil refinery is like before purification in order to demonstrate to you our task. It is black, sludgy, noxious and foul smelling. One of its most stubborn contents is phenol, which is so pungent that one pound of it can be detected in 12 million gallons of water.

However, in spite of what I am sure you can appreciate were major technical problems, our objectives were accomplished and today we are returning water to Lake Ontario in a form purer than it was when it left the lake in the first place.

Very few people realize that water is an important factor in an oil refining operation. In our new refinery, we use a large quantity, more than 2 million gallons a day.

The waste water treating process at the refinery is one that has been developed after many years of research by Cities Service. We believe it to be the most modern and the most effective in the world. With your permission, we should like to show you a photograph of the plant which will illustrate the nature of these operations.

We have some photographs which I would like to show you later. In this plant, we have utilized a mixture of old, established methods, as well as new ones of a complex and biological nature. Perhaps, one of the most fascinating aspects is one process which has been going on in nature for billions of years. It is the utilization of bacteria, or "bugs", as we call them, that feed on the refinery waste and through their digestive processes eliminate much of the noxious content. Actually there are bugs which eat phenol and wax and grow fat on it. This destroys them in that manner. We believe this use of nature's own processes is typical of the many advanced techniques open to us today in controlling water pollution.

Dr. Frame will proceed later to provide you with details of the waste treatment plant and I will now leave this phase with your permission.

In order to dramatically illustrate to the public and to industry what can be accomplished in water conservation, a 4,000 gallon aquarium housed in this building was built. In this huge aquarium various species of Great Lakes fish thrive in purified water. This has proven to be a great attraction to the public and we have had many thousands of visitors since the refinery was officially opened last spring.

I have some pictures which I would like to pass around to the committee to look at. This particular one pertains to the aquarium, where we use an aquarium. This is an internal view of it.

At the same time a fountain, also using the purified water has been built in a park on the Lakeshore and dedicated to the people of the community. This too has proven to be a most popular tourist and visitor attraction, so popular in fact that this winter we took additional steps and installed a heating system making it one of the few year-round fountains in this area of the country.

Both these measures, as well as others I will outline, have been undertaken because we believe that public education—not only engineering—is the final solution to water pollution. Without an enlightened public, the

problem will not be solved. For this reason, we also have launched a large public educational program aimed at the individual as well as industrial taxpayer.

We are producing a $30,000 colour film on the subject of water conservation.

We have a full-time speaker who addresses close to 100 groups annually.

We encourage visitors to the aquarium and water treatment building through special group tours and weekly open house programs. Thus far, in less than a year some 12,000 persons have seen these dramatic demonstrations of water conservation.

Currently we are sponsoring a series of conservation conferences in cooperation with the Ontario conservation council.

We are also publishing a series of water conservation advertisements in magazines and with your permission I will have copies of these filed with your committee.

In addition, we are undertaking many other special projects and activities such as displays at leading exhibitions, special literature and publicity.

*Our Success:*

Cities Service has, we sincerely believe, been markedly successful in achieving the various objectives that motivated our entry, on this scale, into water conservation.

Technically, we have totally eliminated water pollution from our operations, and achieved this in an industry that has great difficulty with this problem.

Our relationships with our neighbours are very good. I quote, for example, from an editorial in the local newspaper which serves the areas near our refinery.—"The Cities Service Trafalgar refinery went on stream just eleven months ago, on November 1, 1958, and none of the calamity-howlers' prophesies has been borne out. No dust, no dirt, no smoke and the waste water that the refinery returns to lake Ontario is of better quality than what it withdraws from the lake".—"The company has been and is a good neighbour in every sense of the word". —"This newspaper congratulates Cities Service Oil Company Limited on its statesmanlike approach to meeting its promised obligations and hopes that its example will be followed by the other new industrial neighbours that will inevitably come to the Oakville-Trafalgar area".

We have been able to vastly improve our relationship and the stature of the Cities Service name throughout the community of our markets, proving perhaps from a practical point of view that good industrial citizenship can pay its own way.

*Industry & Consersation:*

I have discussed so far the motivation, methods and success of Cities Service activities in water conservation. I would like to conclude my remarks by drawing together two of these areas, motivation and success, and discussing them in the light of a much broader concept—the whole philosophy of industry's responsibilities in the field of conservation.

We feel there are three objective factors which draw industry and conservation together.

(1) Self interest—a vast majority of Canada's industries—producing and manufacturing—are based on the country's resources, both the

renewable resources and the non-renewable ones. It is obviously in industries own self interest to make sure these resources are preserved.

(2) Community interest—each industry is but one segment of groups of businesses and people who live together in one area and who are mutually dependent on each other because they all have the same basic needs which are based on the resources which they all share. As soon as we all realize this the sooner we will all do our part in conservation.

(3) National interest—The greatness of Canada rests in its super abundant resources. It is up to each and every citizen, corporate individual, to make sure they are used to the greatest advantage.

In our industry, the oil industry, we have a very basic interest in conservation, for, the services we bring the nation, indeed our very livelihoods, are supplied by one resource. It is as simple as the fact that our business only lasts as long as there is oil in the ground. Of course, this is not a new fact to the oil fraternity and stringent conservation methods have been in effect in the oil fields for more than 30 years. I am happy to be able to say that the founders of our company were among the leaders in the struggle to provide these measures which would allow mankind to derive maximum benefit from each oil field which was tapped.

Today, a third of a century later, we once again find ourselves in the role of leaders in the conservation field—only this time we find ourselves dealing with a resource which is basic not only to our industry but to every industry, indeed to all mankind. Once again we are applying the conservation principle that, we are against both the wasting and the hoarding of resources, and that we stand for the conservative use of the bountiful goods with which we have been endowed. I believe that the conservative use of our resources is the basic philosophy of conservation. We intend to go on practicing our conservation principles in every operation we undertake and I may say that we look forward to playing an ever increasing role in the Canadian economy, including crude oil production out west, transportation, manufacturing and marketing. To all these areas we will carry our conservation practices.

Of course, Mr. Chairman, the question is—will the rest of industry follow along the same pattern? It seems to me that there are ever increasing indications that this will happen in the years to come. I believe the committee is already aware of outstanding efforts made by the oil and chemical industry in Sarnia. My colleagues in the oil industry are continually questioning me about our conservation activities and indicating similar lines of thought and action.

Other industries have different pollution and effluent problems which will take money and research to conquer. However, with the spectre of foul waters causing a continually greater awareness of this pollution menace, I am sure that with governmental assistance and guidance, industry will cooperate to the fullest in the struggle to conserve man's most vital prerequisites—water.

The CHAIRMAN: Thank you very much, Mr. Hull.

I am sure that some of the members of the committee would like to ask you questions at this point.

Gentlemen, have you some questions?

Mr. DOUCETT: I was very interested in this brief. It certainly makes us feel that a great deal can be done in this respect. Living as I do, on a tributary of the Ottawa river—I live on the Mississippi—I think of this very beautiful river that we have, which goes through Ottawa, from which they take their water and into which they empty their sewage.

I think your brief, Mr. Hull, exemplifies what can be done in greatly improving this situation in this city and many of the towns along the way, which are in need of such attention.

From time to time we have found that certain very beautiful—or would-be very beautiful beaches, have to be closed at certain seasons of the year due to, I would think, lack of what you have explained in connection with the purifying of the water that goes back into this very beautiful river, that I have mentioned. What is the answer to that—some set-up which would have a sewage purification plant for the disposal of that back into the river, thereby preventing this obnoxious raw sewage going back?

Mr. HULL: Well, sir, of course—

Mr. DOUCETT: Would the answer be a proper sewage disposal plant?

Mr. HULL: The answer would be to simplify a most complicated question —water treatment processes for all industry that is located in that area. We are talking about something that is a terrific problem, where you already have established industry. All I can say is that you establish a gradual encouragement and exercise some degree of control on these industries. I think that that, in time, would bring that about. However, it is a pretty long-range program, before this is accomplished.

Mr. DOUCETT: The answer would be a sewage disposal plant into which all industry of the city could empty, in order that it would be purified, as you have mentioned.

Mr. HULL: Yes. I believe Dr. Frame, when he presents his remarks, will discuss a few situations of that kind, where certain rivers have been cleaned up by cooperative control, cooperative effort, and some degree of government control. I think he will touch on that subject a little later.

Mr. HICKS: You stated that you put water back into a lake, or a stream, in better condition that when you took it out. Would that apply if you are taking it out of the ocean and putting it back? I am thinking of the salt water content. How much more difficult would that be?

Mr. HULL: It would be much more difficult, because you would have salt to remove. However, it could be done, likewise.

Mr. HICKS: Do you know whether it has been done?

Mr. HULL: Because we have taken it out of the lake, where it is not drinkable, and put it back, where it actually can be drunk, if anybody felt so inclined—because it is that pure—we know it is physically impossible to do it.

Mr. HICKS: The point I am talking about is this. If you took it out of the ocean, where it is salt water, to start with, would it be much more difficult than taking it out of the fresh water, such as a lake, or stream?

Mr. HULL: I would say so, because of the salt problem. Mr. Frame can answer that for you, as he is our technical man in those matters.

Mr. FLEMING (*Okanagan-Revelstoke*): Mr. Chairman, I am trying to get down to the actual cost of what an installation, to achieve this purification, is.

I notice that Mr. Hull mentioned that $1 out of every $8 has been expended on good housekeeping measures. Is it possible to extract what cost was involved in the purification processes of the water throughout the operation. What proportion was for that purpose only?

Mr. HULL: I can tell you that. You want to know of the total money spent, how much went into the water processing.

Mr. FLEMING (*Okanagan-Revelstoke*): Yes.

Mr. HULL: Around $2 million, of the $3 million spent, within that direction.

Mr. FLEMING (*Okanagan-Revelstoke*): That was in an installation, where the total cost was between $27 million and $30 million.

Mr. HULL: Yes. It is pretty costly, as that indicates.

Mr. MACRAE: This is a most interesting and useful presentation. I believe it is the most useful thing we will hear all day.

On page 4, Mr. Hull said:

> It is my personal opinion that more industries would benefit from investing their funds in actual good works than by spending money merely to tell the public how good they are.

I cannot help observing how much better it is to do this than to pay $50,000 or $100,000 for a second rate fifteen-minute program—and pay it to an overrated television entertainer, for himself.

Is the work which you are doing at Trafalgar an entirely new venture in your company's activities, or did you have a pilot experiment in the states to guide you?

Mr. HULL: No, this was entirely new. As far as we were concerned, we pioneered not only in the industrial field, but we were pioneering for Cities Service, because we had never gone into the water problem to this degree.

The process we used was new; the plant was new, and we can only say there was nothing like it in the world. That is no braggadocio; that is a fact.

Mr. MACRAE: I think you are doing a wonderful thing.

Mr. MITCHELL: In spending this amount of money for your original program, have you any estimate of your yearly cost of operation of this continuing program?

Mr. HULL: I think I can quote that from memory. You are referring to the cost of operating the water treatment facilities.

Mr. MITCHELL: Yes.

Mr. HULL: It runs approximately $10,000 a month for materials, manpower, and so forth, outside of the investment involved to run the water treatment plant.

Mr. MITCHELL: That is the point I am getting at. It is adding to your cost of production.

Mr. HULL: Yes, we have more cost in that respect, than any other refinery —and we go overboard on that expense.

The CHAIRMAN: Do you recover any by-products that have a market?

Mr. HULL: The only thing is some oil which we put back into the stills again for refining. There is some oil in all this water. Other than that, there are no by-products from this process, which we can sell.

Mr. MITCHELL: Phenol, or carbolic, is not recoverable?

Mr. HULL: It would be recoverable if we decided to recover it; but I do not think that commercially it would be of very much value to us here.

Mr. KINDT: You have no objection, as a company, to making available to other companies that are in the planning board stage the benefits of your experience?

Mr. HULL: Not at all. We would be happy and flattered if they would come to us, and we will show them everything we are doing and everything we may have current in this procedure.

As a matter of fact, our competitive companies in the oil industry frequently call at our refinery and go through this water-treating process, because they all have the same problem, wherever they are located.

The CHAIRMAN: Mr. Hull, were you subjected to any city or provincial legislation that required a partial solution of this water pollution?

Mr. HULL: Very definitely. I will describe that. I touched upon it in the brief, but not too completely.

When we applied for zoning in that area down there, which is a residential and agricultural area, there was much opposition just on the general idea of refineries coming in. Shell and Cities Service applied jointly, because Shell has a piece of land they are not using as yet. They are going to build a refinery later.

A committee was established in the township which set up some very rigid standards in the by-law that was passed. The standards were established, as I understand it, by the Ontario water resources board as to the quality of water we would have to produce in our effluent. That was rigid, of course, and we realized it would be quite costly to do it. Frankly, we decided to go further than that, because we wanted to capitalize with something unique, so we went beyond the standards that were established for us. But there were certain standards that were very rigid, and that are much more rigid than most oil companies today have imposed upon them.

So it was somewhat with the jurisdiction of the Ontario water resources board and their guidance that we went into this particular activity in that manner

Mr. MITCHELL: Your neighbour there, B.A., does not have this particular process that you have; is that correct?

Mr. HULL: No, they do not have that.

Mr. MITCHELL: They have had some severe criticism about water pollution fairly recently; I know that.

Mr. HULL: Recently?

Mr. MITCHELL: Well, within a few years.

Mr. HULL: Yes, within a few years. And that was one of the reasons that made it difficult for us, because of practices that had gone on in the area when we came, where they were definitely determined to clamp down on us—and we had to meet that problem.

Mr. MCFARLANE: Mr. Chairman, I would like to ask Mr. Hull if this colour film that you are producing will be available to the public?

Mr. HULL: Yes, very definitely. We plan to use the film for any public concern. We had this in mind, primarily, for schools and colleges—particularly for high schools and colleges—where they might be studying this kind of problem in chemical classes, biology classes, and so forth. We thought it was a very fine thing to try to create in the youth the consciousness of this pollution problem that has affected everybody in this area.

So we would have no restriction on its use, but we had in mind its use strictly from an educational standpoint. It is not a commercial film.

Mr. MCFARLANE: Are you going to make this film available also to western Canada?

Mr. HULL: Definitely. Anywhere they want it. All over the world, if they want it.

We expect to have this film, by the way, by about mid-summer. It is being worked on now and is being produced in colour. We think it would be a very fine and interesting thing for Kiwanis clubs, Rotary clubs, or anybody or group that is interested in the subject.

Mr. FLEMING (*Okanagan-Revelstoke*): Mr. Chairman, this question may not be entirely relevant; but one of the things we have heard about over the past several sessions in this committee has been the problem of waste in harbours, where ships flush their waste oil, and so on, into the harbour.

As a consequence of the research and development you have done, have you perhaps formed any opinion about the establishment of smaller units, or units that could be established separately from a refinery operation, in harbour areas, where this waste oil could be taken, gathered from the ships, processed and returned into the harbours in pure form?

Has anything come out of your research in that respect?

Mr. HULL: I am not familiar with any practice of that kind. Perhaps Dr. Frame could tell you about that.

Dr. J. D. FRAME (*Director of Waste Treatment, Cities Service Oil Company Limited, New York*): In many areas, particularly on the eastern seaboard, the gulf coast and west coast of the United States, they have put in very stringent regulations and they are enforcing them very strongly on ships.

You are apparently referring to washing out tanks, or bilge-water, and so on. Most of the refineries—for example, our refinery at Lake Charles, which is on the inner coast of the seaway, when ships come in there they are required to discharge any water they may be carrying to storage tanks at the refinery. The reason for the storage tanks is that the ships pump off that water at tremendously high rates, and the treatment facilities would not handle that flow. We have a smaller flow from the refinery. So we pump it into the storage tanks and bleed it into the system gradually.

I know our own company has on at least one occasion reprimanded very seriously one of the captains of one of our own tankers who discharged oily waters into the inner coastal canal as he was leaving the refinery. So there are steps being taken both by the States people and by the companies themselves to restrict that sort of thing.

Mr. FLEMING (*Okanagan-Revelstoke*): In harbours where no refineries exist with the treatment plants, could plants quite separate from a refinery operation be established that could treat these wastes in the same fashion as you are doing in the areas where there are refineries located? Will these plants operate successfully separately from refinery facilities?

Dr. FRAME: Oh, yes.

Mr. FLEMING (*Okanagan-Revelstoke*): Thank you.

The CHAIRMAN: Are there any further questions of Mr. Hull? I would like to ask you one question, Mr. Hull. I presume that when you were first faced with the city regulations, by-laws and provincial regulations, it rather frightened you a little?

Mr. HULL: It very definitely did.

The CHAIRMAN: Are you glad now that you had such regulations?

Mr. HULL: I can say frankly that we are very happy about it now. We were staggered a bit at first, but now we have done it, we think it is a very fine thing to do, and we are happy with the result.

Mr. DOUCETT: Is it prohibitive, or would it be prohibitive for a large municipality such as this to enter into such a project of sewage disposal plant —or is there any yardstick on which it can be figured out for the population, per capita?

Mr. HULL: I would like to refer that to Dr. Frame, because that is getting into the technical area of this matter.

The CHAIRMAN: Perhaps you would take over now, Dr. Frame.

Mr. HULL: Perhaps Dr. Frame could give a little discussion on the situation, and then I am sure he would be glad to answer that.

Dr. FRAME: First, my responsibility lies largely in directing the waste disposal facilities for all of our refineries, both here in Canada and in the United States.

I think we bordered on the question as to whether we had done anything at the rest of our refineries similar to what we have done here at Trafalgar. Mr. Hull answered that in fact we had not. However, I would like to quality that statement and expand on it a little bit. At all our refineries—and we have five in the United States, plus the one at Trafalgar—we either are providing treatment currently or are in the process of providing additional treatment which will in every case produce an effluent which is entirely acceptable to the regulatory people in those areas.

So it is not something we just did at Trafalgar and said we were not going to worry about at the rest of our plants, because we are, very definitely, and we are spending in the neighbourhood of $\$1\frac{1}{2}$ million on our other plants this year to expand our facilities further in the United States.

My little discussion will be somewhat guided by the questions that have been asked of Mr. Hull. There is one other thing that I would like to bring up. It is this, and I think it is extremely important. It is the fact that our job at Trafalgar was made much easier by the very fact that the province of Ontario did have regulations and specific requirements for refinery effluents. I can illustrate that by pointing out that much was done in the planning stages for the basic refinery itself, particularly with respect to the water that is used in the refinery. Knowing beforehand that we were going to go to an exeremely high degree of treatment, it immediately became obvious that you would want to keep your water flows from the refinery to an absolute minimum. Locating where we did on Lake Ontario, there were many people in our company, particularly the operating people and the engineers, who wanted to go to a once-through water basis on this refinery. That means, just pumping the water out of the lake, through the refinery once and letting it go directly back to the lake. In this particular refinery, if we had done that, instead of pumping out of the lake and returning only 2 million gallons a day, we would have pumped and returned 32 million gallons a day. It would have been prohibitively expensive to us to put in comparable facilities to treat 32 million gallons a day, from what it is to treat 2 million gallons a day.

So I would like to stress particularly that it is of extreme value to any industry moving into an area that the regulatory people, the people who are in charge, have a say about the character of an effluent that has to go back to an industrial water course. The very first thing they should do once a group is formed, or established, is to begin to develop standards that industry is expected to meet, because on the question of our neighbours on Lake Ontario, those refineries were built some years ago, and I am sure that at the time they were built there were probably no standard, or the standards were very general.

As a result, for economic reasons, for ease of operation, from the standpoint of economics, the ideal thing to do was go to once-through water. They both have once-through water, so they probably have flows back to the lake of some thousands of gallons a minute, whereas our flow back to the lake is something less than 300 gallons per minute. You can do many things with a flow of 300 gallons per minute that you cannot do with 3,000 gallons per minute, for example. In our case, it would have been 23,000 gallons per minute. I would like to stress that one point as being very important.

Another question was asked about more or less a cooperative effort between industry and municipalities. A classic example of what can be done by cooperation between—again I refer to the United States—industry and municipalities is illustrated by the Ohio river sanitary commission in the United States. That commission is made up of eight states which border on the Ohio river on its major tributaries. This group has worked for, I would say, the last 10 years and has accomplished great strides in that period of time in cleaning up the Ohio river.

You might like to know just how this group works. Each state provides a representative to the commission itself. The commission is supported financially by each one of the states, and the commission has hired and has a working engineering staff who are full-time paid personnel.

This group is directly responsible to the commission and is the group which, in turn, works directly with industry or municipalities, depending on the individual case. This engineering group has carried their thinking, their planning and their programming one step further, particularly with respect to industry.

They have got the major categories of industry, namely, the petroleum, paper, steel, and the pharmaceutical industries, to form industry action groups, and before the commission acts on any legislation, the engineering group for the commission contacts these action committees for the industry, works with them and tries to come up with realistic legislation which industry feels they can abide by. Once the industry and this engineering group have come up with some form of agreement, then the engineering group goes back to the commission. Only then does the commission take action in passing any regulation which may affect pollution on the Ohio river. This system has been extremely successful. In the whole Ohio river drainage basin today 98 per cent of all the communities are providing some form of sewage treatment before discharge. That is a pretty good percentage. All this has been accomplished in the last ten or twelve years. Incidentally, this commission does have teeth in its legislation. On occasion they have brought action against municipalities and industry. They do not take a case to court until they are pretty sure of their ground. In their actions against industry and municipalities they have been able to enforce the desired degree of treatment. So far as the United States is concerned that is probably the classic group. There are other groups throughout other parts of the United States, but I do not think any of them have had the same degree of success as has the Ohio river group.

The question was raised as to whether or not the cost of waste treatment, particularly to a municipality, is necessarily prohibitively expensive. I do not know of any case where it has been proven to be prohibitively expensive. Nobody, quite obviously, is happy to have the tax rate increased in order to finance sewage treatment plants, but by the same token communities, at least so far as the United States is concerned, are growing month by month and you get less for every dollar you spend; so it only seems reasonable that all municipalities should face up to the fact that this is inevitable and it something they will have to do and by postponing it they are not accomplishing anything. The problem is not going away. It will get worse if it does anything.

That is further illustrated, for example, by the fact that in respect of the Ohio river they have no compunction about taking people to court and forcing them by court action. I have yet to hear of an area which went out of existence because somebody forced them to put in a sewage treatment plant. Certainly, today in general, and specifically in so far as municipalities are concerned, there is ample technology. The lack of know-how is not a factor in making a decision as to whether or not you are going to put in a sewage treatment plant. By and large in most of the industries the technology does exist today to treat the wastes adequately. I think we have demonstrated that in respect of our particular plant. We went further than anybody else has gone in the petroleum industry. We used some processes in that plant which never have been used before. We did some experimental work and there was information in the literature of other research done by other people. Certainly there is know-how and technology both for domestic sewage treatment and for, I would say, a majority of the industrial plants. The excuse that there is no treatment method is not, in most cases, a valid excuse.

I have worked very closely with the provincial people in Ontario. It was really a very rewarding experience for myself. They took a very realistic approach and a helpful approach. They did everything to help us they possibly could. Obviously they encouraged us. When it was all said and done I was thoroughly pleased and enjoyed the relationship in working with the Ontario water resources commission. I feel we both certainly have derived a good deal of benefit from the relationship.

I do not know whether or not you gentlemen are interested in my going through what we did at the Trafalgar refinery. Perhaps you would rather ask me questions.

The CHAIRMAN: What is the wish of the committee? Would you like to delve into the technical aspects of this, or would you prefer to ask questions? I think perhaps we might start to ask questions.

Dr. FRAME: I would just like to reemphasize this point.

The CHAIRMAN: You might give us a brief outline of the overall technical aspects.

Dr. FRAME: On the plan Mr. Hull mentioned, of course, one of the toughest of materials we have to handle in any refinery are the phenolic compounds. They in themselves are not too bad and in fact if we did not chlorinate our water supplies we could tolerate phenol in the water perhaps as high as half a part per million before you would get any taste in the water; but the minute you chlorinate the water the phenols then become chlorophenols. They are dangerous put in the water supply at a concentration of 5 parts per billion which is one-hundredth of a concentration of pure phenols by themselves. That is one reason why if a refinery is discharging into a river which is ultimately used as a water supply source the problem becomes much more critical. The problem is not as critical in salt water as it is in respect of a fresh water supply that is being used for drinking water purposes. There are other compounds we have to deal with in our refinery. Of course, there are oils; that would be obvious. Sulphides—hydrogen sulphide is another bad actor we have. Then we get into the B.O.D., which is the biochemical oxygen demand. B.O.D. is the measure of organic materials present in there. They go through a watercourse and immediately are attacked bacteriologically. They require oxygen, and if the B.O.D. is sufficiently high to stimulate rapid growth of the organisms they deplete the water of the oxygen; and then you go into the anaerobic condition where the organisms reduce the sulphites to sulphides.

$p^H$ is another factor. $p^H$ can fluctuate quite widely, from strong acid to high base, and that requires adjustment.

In the refinery facilities we have constructed, we have built A.P.I. design separators for the recovery and removal from water of any free oils that may be present.

The water goes to the equalizing basin, and that has a 24-hour retention time. It was put in the plant in order to permit us to equalize or to level out the variations in the character of the waste. The character of the waste from the refinery varies quite widely over any given 24-hour period.

Following the equalization basin we go to the chemical treatment of the waste. This was done for two reasons. The chemical treatment selected permits us to trap chemically the sulphides and permits us to trap any oil and water emulsions.

Following that part of the plant we control the temperature of the water and bring it up to about 95 degrees. Then it goes through the biological waste treatment portion of the plant; and that is really the home of the bacteria or the bugs. Under controlled conditions these organisms will utilize

the phenolic materials and other organic materials present in the waste, as a source of food and energy; and they are subsequently removed.

Another biological treatment portion of the plant is designed to remove the soluble organic components, by getting those materials into the type of bacteria growth which will form into a fluculent material, like wet snow coming down. They have enough weight and can be separated out.

At this point we have half a part per million of phenols still remaining in our water, which is entirely unacceptable from our standpoint and from that of the provincial people. To get below half a part per million entails prolonged aeration time and large expense. Rather than go to that longer aeration time we decided to go to chemical treatment; and that is where we stepped out of the conventional.

We installed facilities to generate ozone. Ozone, of course, is a powerful oxidizing agent. By taking this and putting them in contact with ozone we are able to reduce phenol concentration from half a part per million to 30 parts per billion. This does not meet the standards we have set up, and we use another form of chemical treatment. We add activated carbon to the water, and that has a strong affinity for the residual phenol, and the phenols absorb that activated carbon.

The final stage is the rapid water filtration, and like most water treatment plants this permits us to filter out the active carbon, and removes any other suspended material which may be present in the water at this point. Incidentally, the ozone is a strong disinfectant, and is being used in a number of areas, particularly in water treatment plants. It has a fundamental advantage over chlorination. Even at 5 parts per billion it is below the phenol concentration we have been striving for. If we were to chlorinate the water we would run the risk of having water with a strong odour to it. Ozone does not have this effect, and it does give us an entirely satisfactory bacterial quality of our refinery effluent.

We have two labs, the bacteriology lab and the chemistry lab. We have two full-time and one part-time man running the chemical and biological analyses. At all times we know where we stand both treatment-wise and effluent quality-wise. At the plant we have provisions whereby, if the effluent is not of a satisfactory quality to discharge to the lake, we can retain it and re-run it through our plant. In no case does water go to the lake that has not been checked first by the laboratory.

I hope I have not been too technical, but that is what was involved at our Trafalgar plant.

Mr. Kindt: While we are on that subject, may I ask if your bacteriological lab plants the bacteria of the type you wish to do the job you want done? In other words, is it specific bacteria?

Dr. Frame: Yes, they are specific bacteria, but they are any extremely common bacteria; and depending on whether you have time or not, you can just take the refinery effluent, which includes some surface drainage, and you can put it in aeration tanks and feed it. Then, in a very short period of time—in a matter of four or five days—the bacteria grow to a point where you have a substantial population. In our particular case we take a tank truck and get about 10,000 gallons of bacterial seeding material from the Oakville activated sludge plant. Actually, there is no effort to try to select or maintain a specific type of organism. The organisms just come, and they will stay.

Mr. Doucett: Doctor, you mentioned, I think, that if you did it the way some other industries did it, instead of the million or two million you would pump in about 32 million.

If you had that system or used that quantity, would it be purified when you put it back into the lake; or is it, under the system which they use?

Dr. FRAME: No, it is not and it would not be. Some people may argue with me, but this is the position I took when this was discussed with our own company people. If we had put in 32 million gallons we could not have turned the effluent back to the lake and met the restrictions on the part of the Ontario water resources commission.

Mr. DOUCETT: On the question I asked some time ago, about the possible cost to a city such as the city of Ottawa, is there any yardstick by which we could get a reasonable figure for that? If they were to put in a plant which would treat it in the way you have mentioned, then we would have a river which would be recognized as one of the finest in all Canada.

Dr. FRAME: Yes, very definitely. I do not have those figures with me right now, but I am sure I could put my hand on them.

I know that the city of Toronto has gone through a recent expansion of their facilities. A common yardstick is, first you have to decide on the degree of treatment that is required, and then to go to cities or municipalities that have recently built comparable plants. Then the cost of those plants can be related to the population possessed. On that basis you come up with so many dollars per capita per year.

Mr. DOUCETT: The cost would not be prohibitive?

Dr. FRAME: I would say that it is not.

Mr. DOUCETT: If I may ask another question, Mr. Chairman, I understand that you have mentioned, Dr. Frame, that you have had considerable experience in the United States of America. I understand that the federal government make a grant there of a certain amount; and I have read recently that the communities there that are interested in it have been spending about $4½ to every $1 granted by the federal.

Dr. FRAME: Yes.

Mr. DOUCETT: And that they have spent fairly large sums of money. In fact, I think I did notice the figures for 1958 or 1959, where it went up to about $389 million to $400 million. So there must be such a program being carried on in many of the cities of the United States?

Dr. FRAME: That is very true. That was an inducement. I do not know how much of an inducement it has been to the municipalities, when they have been forced into doing something that has made their job somewhat easier; but there is still the old reluctance even to spend the 50 per cent of the cost on the part of the municipality.

Mr. DOUCETT: There is another very important factor in the long-term plan, and that is the conservation of water by this system. If you pollute great quantities of water, they are saying it would become a very dangerous situation in the future.

Dr. FRAME: That is so. We are experiencing in certain parts of the United States actual shortages of water. For example, I know of at least one refinery in Oklahoma that is completely restricted as to future growth, due to the lack of satisfactory water. Even currently they are utilizing the effluent from the local sewage treatment plant for cooling water in the refinery, because they are that short of water. It is going to become an increasingly serious problem.

Mr. DOUCETT: Especially at the very rapid rate the population is increasing.

Mr. PAYNE: I was interested, Mr. Chairman, in asking the doctor regarding the jurisdictional picture along the Ohio. Who legislates and sets standards?

Dr. FRAME: The commission itself does.

Mr. PAYNE: The commission is set up upon what basis?

Dr. FRAME: There is one representative from each of the eight states.

Mr. PAYNE: It is an inter-state group?

Dr. FRAME: Yes, an inter-state group. All the states apparently pass legislation. Each of the states still maintains its own enforcement agency, because there are many places in all those states where municipalities or industry do not discharge effluents into the Ohio valley system.

Mr. PAYNE: What is the jurisdictional situation, and where does the federal come in? Do the states pass enabling legislation to cooperate under a federal project?

Dr. FRAME: There is no federal project.

Mr. PAYNE: There is no federal responsibility recognized?

Dr. FRAME: No.

Mr. PAYNE: The standards are set up individually by the states, and not by the commission overall, for all of the states?

Dr. FRAME: Yes. You have two responsible groups in each of the states. The state is responsible and sets up its own rules, regulations and requirements for all plants which do not discharge either directly or indirectly into the Ohio river. When a plant or municipality discharges either directly or indirectly into the Ohio river, then it comes under the jurisdiction of the Ohio river sanitary commission.

Mr. PAYNE: It is a body set-up on a joint agreement?

Dr. FRAME: It is a body set-up on a joint agreement by each of the states.

Mr. PAYNE: There is no federal representative?

Dr. FRAME: There is no federal representation.

Mr. PAYNE: And is there federal participation, financially, or not?

Dr. FRAME: There is no federal assistance.

Mr. PAYNE: And is there federal participation financially?

Dr. FRAME: There would be to the same degree that there is to any other community in the United States.

Mr. PAYNE: The Ohio is regarded as a state responsibility, and not a federal responsibility?

Dr. FRAME: Well, it is not a commission responsibility.

Mr. MITCHELL: Mr. Chairman, may I ask Dr. Frame if he could give us a rough idea of how many gallons of water would be required to produce a gallon of gas? I do not mean water that you get in the bottom of your tank in a motor car.

Dr. FRAME: It varies very widely between one refinery and another. But in our particular case it is about 100 gallons of water per barrel per day.

The CHAIRMAN: That is at your Trafalgar refinery?

Dr. FRAME: That is right. And you can multiply that by something close to 100.

Mr. MITCHELL: That is 100 gallons to a barrel?

Dr. FRAME: Yes.

Mr. MITCHELL: And a barrel is 40 gallons?

Mr. HULL: Thirty-five gallons.

Mr. MITCHELL: Well, I was close. But what I am trying to get at is: of the amount of water received at your intake per day, how much would be lost in your routine?

Dr. FRAME: The only water we would lose in the return is the water which is lost in our cooling towers.

Mr. MITCHELL: You would return 90 per cent of it, or 95 per cent of it?

Mr. HULL: We take in about two million gallons a day, and we turn back about one million gallons a day. The difference is in the evaporation from the cooling towers, plus the water which is used for the manufacture of steam for internal use in the plant. So we return about 50 per cent of the water which we take in.

Mr. MITCHELL: That is what I was driving at. I was thinking of the conservation idea, and perhaps an eventual scarcity which we might have, even in our own great lakes system.

Mr. MACRAE: Dr. Frame referred several times to the Ohio river. I think that is most interesting to us. Was not the Ohio or at least one of its tributaries rapidly reaching the point where it would be a dead river, where nothing at all would live in it, and where the water would be useless until after it was purified I understood that the Monongahela had reached that point.

Dr. FRAME: That is correct. And you could find probably a more classic example than that. The Ohio takes in the whole drainage basin. And I refer to the Schuylkill river at Philadelphia where, prior to the war, people could hardly tolerate the conditions existing along that river. The odors and everything were just impossible. So they put on an intensive campaign to clean up the Schuylkill. The result is that today fish are back in the river, and there is boating on the river. They have always taken water out of the river for drinking purposes at Philadelphia. It was always a question in my mind whether it was fit to drink, although it was quite safe to do so. But today you can drink a glass of that water without having to take medicine.

Mr. MACRAE: This river had reached the point where no fish life could live in it?

Dr. FRAME: That is right. And what they did was to put in sufficient biochemical oxygen, that is, dissolved oxygen in the water. It affects certain types of fish, but I do not think it affects game fish at all. You try to keep it down below two per cent per gallon, otherwise you will kill off all the game fish that might be present in that water.

Mr. KINDT: You gave us two figures, one of two million, and the other of 32 million. Am I correct in understanding that the same water is used many times over, let us say, 16 times?

Dr. FRAME: That is correct.

Mr. KINDT: And my second question is this: where it might not be practical to use your reverse treated sewage waste, there would be a different treatment problem with possibly more cost involved in setting up a sewage treatment plant?

Dr. FRAME: I do not think I quite follow you.

Mr. KINDT: Where you are treating sewage in a city, it would not be possible—or would it—to use the water over and over again in the sample plants, and to put it into the pipes, and pipe it back to the houses, so to speak, or, from the very nature of it, you would not do so?

Dr. FRAME: From a technological standpoint today it is possible, but it is not advertised. There are areas in the United States where in fact it is being done. You do not do it in the same community. The community upstream would put its water back into the river, and another community, let us say, 50 miles downstream, would take that water out and use it.

Mr. KINDT: I can vouch for that.

Dr. FRAME: I honestly and firmly believe that in my lifetime I am going to see water resources conserved within the city itself, because water is going to become critical. In fact we have done that at Toronto.

The CHAIRMAN: Are you familiar with the oil refining industry on the Pacific coast in British Columbia at Burrard inlet and Vancouver harbour?

Dr. FRAME: I am only familiar with it in the Seattle area.

The CHAIRMAN: I suppose you would know if any of those refineries are using the same conservation process that you are thinking of using, that is, the once through process?

Dr. FRAME: Next to our plant here, as far as the degree of treatment is concerned, there are those three plants that I mentioned: the Texaco, the Shell, and the General Petroleum at Anacortes and Ferndale, Washington, where they have spent large sums of money at these three refineries in the way of developing waste disposal.

The CHAIRMAN: I was referring particularly to British Columbia, and I wondered if you had any knowledge of what particular setups there are there?

Dr. FRAME: I am sorry, but I do not.

The CHAIRMAN: Are there any further questions?

Mr. HULL: I wonder if Mr. Hicks would mind repeating his question concerning the use of salt water, because I would like Dr. Frame to answer it.

Mr. HICKS: My question was about returning this salt water after they had used it, and I wondered how much more difficult it was to do that, when the water is salt, than when it is fresh?

Dr. FRAME: It is no more difficult, and in fact, as was said earlier, your requirements are generally not as stringent.

The thing you have to watch out for—and refineries are particularly bad in that respect—is if there happens to be any shell fishing—oysters and so on—in the immediate area of the refinery discharges—because, of course, oysters, and so on, filter tremendous quantities of water, and they will take on the taste of phenol materials, if they are present in heavy concentrations. Normally, if the refinery effluent is treated to the point that it only has one-half a part to a million in it, it does not create any problem.

Mr. HICKS: I have another question, Mr. Chairman, and it is in regard to the 1948 flood in Agassiz, British Columbia.

Agassiz was a town of about 600 people. It was a cesspool town, and a well town. The whole town got flooded, and had two or three feet of water all over it. The cesspools were working in reverse, and the wells were full of this water. In three weeks, the water went away, and everything went back to normal. I do believe that some of the wells were not inspected. Although I do not know whether tehy were treated, the amazing thing to me was that there was not one trace of sickness—not even a case of sore throat. There were no lives lost in that situation.

Was that good luck, or good management?

Dr. FRAME: Good luck.

Mr. SIMPSON: Mr. Hull mentioned that the water going back into lake Ontario was fit for human consumption—or, fit to drink, if anybody cared to drink it.

Could you tell us how that water, which you are putting back into the lake, would compare with the water you are taking out of the lake? I would also like to know how the water you are putting back in would compare with the water we are using for human consumption out of certain city water supplies.

Dr. FRAME: Our water, currently, is better than the lake water, in two respects. First—and, probably, most important—bacterially, our water is better than the lake water. Secondly, we run continual checks on the lake water.

Almost invariably, the lake will contain phenol concentrates in excess to those in our effluents. The only physical or chemical characteristic which we are altering, to any degree, in the water going back, to the water coming in, is that we are increasing, maybe twofold, the dissolving solvent, containing primarily calcium and magnesium. We do that through our cooling tower, which operates on the basis that if you are going to evaporate some of the water, it tends to concentrate some of the dissolved solids. But certainly, in going from 200 parts to 600 parts per million, I would say there are many places using domestic water which has higher than 600 parts dissolving solvents present in it.

Mr. McFarlane: If this water that is being run back into the lake is more fit than what comes out, why not run this back through the plant again?

Dr. Frame: Well, there are two answers to that one. First, let us face it—if we do not have an effluent going back, we would not have anything to talk about. Secondly, the dissolved solids—if we take that water back, and continue to add those dissolved solids, no system could retain them, and we would bog down with dissolved solids. We would experience, not coagulation, but serious depositions of solids on our equipment. The basis is to control your dissolved solids up to a certain level, and you chemically treat. There is a balance between the solids you can tolerate in the water, and the cost of adding agents, such as poly-phosphates, to keep them from depositing on your equipment. But, from an engineering standpoint, 600 parts per million of dissolved solids coming in, would be, in effect, what would happen, if you brought the water back. It is reaching the point where you would get into trouble in servicing and maintaining equipment.

Mr. Kindt: You were saying that you filter out certain carbon compounds. Do you dispose of these as a by-product?

Dr. Frame: Yes. They are retained on the surface of the sand filters. Periodically, the deposition on the discharges comes to the point where it affects your flow-through and you have to back wash the filter. You have to put water up through the bottom of the filter, and all that water is conveyed back to the head end of the plant. It ultimately reaches chemical coagulation. We have facilities for concentrating these solids. They go through a filter, where they are dewatered, and the semi-dried solids are held within the plant. We have a contractor who takes those solids away.

The Chairman: You spoke of the use of ozone, in place of chlorine, for purifying water. Is it a more costly process?

Dr. Frame: The cost of the equipment is more expensive. Your operating costs are less and, as I pointed out, that is the obvious advantage. Many municipalities have satisfactory water in evry respect, other than the fact it may contain a small residual of phenol. It may not be contributed necessarily as a result of industrial pollution. That is frequently overlooked. You could go to many pristine pure streams, and if they run through the heavily forested area, they pick up a large number of leaves and so on. The bacterial composition of this natural organic material, such as leaves, will release a certain amount of phenol.

You may have water that does not have a taste, and the minute you chlorinate it, it produces a very pronounced taste. For instance, in Philadelphia, in the Schuylkill river, they could not possibly have chlorinated that water, and they put in ozone to give them satisfactory water.

The Chairman: I am sure I am expressing the feelings of the committee when I thank you gentlemen very much for finding time to come here, and for making a most interesting presentation.

I would just like to say a word about the witnesses who will be before us tomorrow. We expect to have Mr. R. H. Clark, who is on the Saint John river board; Mr. John S. Bates, of the New Brunswick water commission; and Mr. R. L. Tweedall, manager of the New Brunswick power commission. Thank you, gentlemen.

(Note: Answer to question asked by Mr. Payne on May 3.)

## APPENDIX "A"

DEPARTMENT

OF

NORTHERN AFFAIRS AND NATIONAL RESOURCES

OTTAWA, 12 May 1960.

Dear Mr. McQuillan:

During the course of the testimony which I gave before your Committee with respect to the Fraser River Board on the 3rd instant, Mr. Payne asked a number of questions with respect to which I undertook to give him answers at a later date. I do not know whether or not you will wish these answers recorded in the printed evidence, but I assume that if I send to you any answers you can decide whether you wish them to appear in the printed record or whether you consider they can be passed on to Mr. Payne direct.

While I have not prepared a complete set of answers as yet, it may be appropriate to forward at this time the information Mr. Payne desired in one particular instance. On page 147 of the printed record Mr. Payne inquired concerning information on the effect of vegetation on logging operations and run-off, and I undertook to advise him of the particular reference made to this item in the Board's Preliminary Report. Accordingly, I am attaching hereto a copy of an extract from the Board's report, which extract has specific reference to the effect of vegetation on run-off as taken from pages 17 and 18.

Yours sincerely,

T. M. Patterson,
Director.

Mr. H. C. McQuillan, M.P.,
Chairman, Standing Committee on
Mines, Forests and Waters,
House of Commons,
Ottawa, Ontario.

Encl.

*2.4.3 Vegetation*

The type of ground cover influences the runoff; trees and plants reduce the quantity of runoff because they transpire a large proportion of the rain which falls on them. Also their root systems provide channels for surface water to penetrate into the ground, and in this way they delay runoff and prolong streamflow by increasing ground water, which returns to surface streams at lower levels. (7).

In order to make a rough estimate of the effect of vegetation, we might begin by deducting about 20% of the area of the basin as being above timber-line (at about 5,000 feet) and therefore without forest cover. The way that the vegetation on the remaining 80% of the area affects the hydrology might be inferred from the experiment at Wagon Wheel Gap, Colorado, which began in 1909 and was concluded in 1928. This experiment deals with the stream-flow from two mountain drainage basins of about 200 acres each, located on the drainage of the Rio Grande in southern Colorado, at elevations between

9,000 and 11,000 feet in the Rocky Mountains. A full description is given in the U.S. Department of Agriculture Weather Bureau paper No. 946, 1928. Without going into too much detail, hydrological and meteorological data for the two areas were obtained from 1909 to 1919, after which one area was deforested. The original forest on both areas had been Douglas fir, but this had been replaced largely by a scrubby growth of aspen after forest fires some 35 years previously. The average annual precipitation was 21 inches, similar to the Fraser River basin, though temperatures were lower. The basic conclusions which have a bearing on the effect of vegetation on runoff may be summarized as follows:

(1) The flood runoff from both areas was the same before deforestation.

(2) After deforestation the spring flood from the bare area increased to a maximum of 35% more than from the forested area in the third year, and, at the end of the experiment, was still 22% in excess.

(3) The increase in flood runoff did not result in lowered ground storage or lowered runoff at other seasons.

(4) The silt load of the stream from the deforested area increased from 5 to 15 times.

(5) The time of the start of the spring flood on the deforested area was advanced by 3 days, and its height increased by 64% on the average.

(6) Deforestation caused the high stages of streamflow to be much higher and the low stages to be slightly higher.

The ability of any vegetative cover to assist absorption, thereby reducing surface runoff and erosion under nearly all conditions, and in particular the ability of forest cover to retard snow melting, cannot be seriously questioned.

Although the results of this experiment could not be applied exactly to the Fraser River basin, the differences in volume, peak, and timing of the spring floods before and after deforestation were large enough to indicate the importance of forest cover in the control of floods. However, in the Fraser River basin, the areas cut for logging are extremely small in relation to the vastness of the forested areas, and as long as this is so the flow of the river, as measured at Hope, will not be affected appreciably, although deforestation could give rise to flooding locally.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 12

---

TUESDAY, MAY 17, 1960

---

Estimates 1960-61 of the Water Resources Branch
of the Department of Northern Affairs and National Resources.

---

WITNESSES:

Dr. John S. Bates, Chairman, New Brunswick Water Authority, Fredericton; Mr. R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch, Department of Northern Affairs and National Resources; and Mr. R. E. Tweeddale, General Manager, New Brunswick Electric Power Commission, Fredericton.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23123-3—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack
*Clerk of the Committee.*

CORRECTION—(*English Copy Only*)

MINUTES OF PROCEEDINGS No. 11—MONDAY, May 16, 1960.

*On Page 219, 5th paragraph should read:*

"The Chairman read a letter from Mr. J. R. Menzies of the Department of National Health and Welfare, who appeared before the Committee on May 9th, correcting evidence with reference to *sewage* treatment in the City of Saskatoon."

# MINUTES OF PROCEEDINGS

TUESDAY, May 17, 1960.
(13)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present*: Messrs. Doucett, Dumas, Granger, Gundlock, Hicks, MacRae, McFarlane, McQuillan, Payne, Robichaud, Rompré, Simpson, and Stearns. (13)

*In attendance*: Dr. John S. Bates, Chairman, New Brunswick Water Authority, Fredericton; Mr. R. E. Tweeddale, General Manager, New Brunswick Electric Power Commission, Fredericton; Dr. A. F. Baird, Executive Engineer, Saint John River Board; *From the Department of Northern Affairs and National Resources*: Messrs. E. A. Côté, Assistant Deputy Minister; R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch; J. E. Peters, District Engineer, Halifax District Office, Water Resources Branch; and K. Kristjanson, Secretary, Advisory Committee on Water Use Policy.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Messrs. Bates, Tweeddale, Clark, Peters and Baird and then called on Dr. Bates.

Dr. Bates made an extensive statement on water supply and pollution in New Brunswick and other Atlantic Provinces and was questioned thereon.

Mr. Clark was called and he made a comprehensive statement on the activities of the Saint John River Board pertaining to effects of storage on hydro-electric power potential. He also made a statement on the Terms of Reference of the Saint John River Board.

Copies of a map of the Saint John River Basin were distributed to the members of the Committee.

During his presentation, Mr. Clark emphasized various points by referring to a wall map.

At 11.00 a.m. the Committee adjourned until 9.30 a.m. Tuesday, May 24.

M. Slack,
*Clerk of the Committee.*



23123-3—1½

# EVIDENCE

TUESDAY, May 17, 1960.

The CHAIRMAN: Gentlemen, we have a quorum. Will the meeting please come to order.

First of all, I will introduce our witnesses for today. I have, on my right, Dr. John S. Bates, chairman of the New Brunswick water authority, Fredericton, N.B.; Mr. R. E. Tweeddale, general manager of the New Brunswick Electric Power Commission, Fredericton, N.B. Both of these gentlemen I have named are members of the Saint John river board.

We also have with us Mr. J. E. Peters, district engineer of the Water Resources Branch, Halifax, N.S.; Mr. R. H. Clark, chief hydraulic engineer, Water Resources Branch of the Department of Northern Affairs and National Resources; Dr. A. F. Baird, dean emeritus, applied science, University of New Brunswick, and executive engineer of the Saint John River Board.

At this time, we will ask Dr. Bates to proceed with his presentation to the committee. It concerns water supply and pollution in New Brunswick and the other Atlantic provinces. We will then proceed into the work of the Saint John River Board.

Dr. John S. BATES (*Chairman, New Brunswick Water Authority, Fredericton, N.B.*): Mr. Chairman and gentlemen, it is a pleasure to be with you this morning.

Anyone starting to study water resources and stream pollution soon sees that there is no time to spare in organizing and exercising widespread control. The emphasis should not be on negative restrictions, but rather on positive action. This involves all members of the community, because the function of government is to regulate while the responsibility for water and sewage works should remain with the municipality, company, or individual.

Next, a review of the work in New Brunswick. We have been at this for two years.

The population of New Brunswick is 600,000, and the area approximately 28,000 square miles of which rivers and lakes cover some 600 square miles. The annual precipitation averaging about 40 inches of equivalent rainfall indicates an ample supply of fresh water. The humid-temperature climate and the forest cover on 85 percent of the land area are favourable factors. The beautiful coastline extends along the east and south of the province. The international boundary between New Brunswick and Maine extends for some 250 miles, and the international sections of the lower St. Croix river and the upper Saint John river along with several rivers crossing the boundary give added variety to the conditions and the problems throughout the province.

In 1956 the New Brunswick legislature passed the "Water Resources and Pollution Control Act", chapter 14. Then followed the appointment of the water resources and pollution control board of nine members, representing five departments of government and four other interests in the province. Their reports led to an amendment to the act, chapter 23, 1958, creating the New Brunswick water authority, now consisting of three members and attached to the Department of Municipal Affairs.

The legislation has established broad jurisdiction over water resources and stream pollution. The instructions are to determine the best present and future

uses of lakes, streams and tidal flats in the province; to preserve the natural beauty of such waters and their suitability for the propagation of fish and aquatic life; to determine how the conflicting interests of various water uses should be reconciled in the public interest; and to avoid wasteful depletion of the water resources. An important section states that in case of conflict with any other legislation, these acts and the regulations shall prevail.

So, we feel we are in a pretty strong position.

Pollution control must include surveys of watersheds to measure the sources and degrees of contamination and the effects on public health, fish and wildlife, agriculture, recreation, power development, and the condition of the water supply for successive users downstream; means of preventing or lessening pollution; and classification of waters according to the uses thereof and the degree of pollution therein.

Then we come to the regulations under the act, which are now in preparation.

Our forthcoming regulations under the act will aim to specify standards and controls for important items such as ground and surface water supplies, the withdrawal of water from lakes or streams, the clearing of reservoirs before flooding, the dumping of solids in waterways, the restriction by municipalities of commercial discharges into their sewer systems, the inspection of industrial plants and processes, the limiting amounts of harmful substances in effluents, and the penalties for violation of any regulation.

The Lieutenant-Governor in Council may appoint a local water authority for one or more areas or watersheds; designate an existing body for the purpose, if desired; and authorize a local water authority to enforce and carry out any regulations and duties for which it may be established. In due course the time may come for this kind of district administration under the jurisdiction of the New Brunswick water authority.

Like most other provinces, New Brunswick has adopted the International Joint Commission's definition of water quality objectives, viz., "All wastes, including sanitary sewage, storm water, and industrial effluents, shall be in such condition when discharged into any stream that they will not create conditions in the receiving waters which will adversely affect the use of those waters for the following purposes: source of domestic water supply or industrial water supply, navigation, fish and wildlife, bathing, recreation, agriculture, and other riparian activities".

You know, also, that under that statement of objective, the I.J.C. has named specific limiting amounts of certain objectionable materials in water.

The water authority to date comprises three members and secretary, all on part time. A small field party operates during the summer season. The provincial laboratories in Saint John provide testing service to handle the physical, chemical, and bacteriological testing of water samples. The provincial sanitary engineer in the Department of Health and Social Services handles the water and sewage problems arising under the health act. The water authority retains experienced consultants for general guidance and for help with special problems.

Already our experience in New Brunswick has indicated that various departments of the Provincial Government (particularly municipal affairs, health, power, lands and mines, agriculture, industry, and Attorney General) are concerned with water in one way or another, and that certain jurisdictions rest with these departments. Likewise, various agencies of the Federal Government are involved (Fisheries, National Health and Welfare, Northern Affairs and National Resources, National Harbours Board, Public Works, Agriculture, National Defence, External Affairs, International Joint Commission and others),

and great assistance in New Brunswick has been gained by collaborating with the appropriate officials. For these reasons, and because every municipality, industry, and individual depends vitally on water, it would be impossible to isolate water for administrative control by any one organization. The New Brunswick Water Authority looks on co-ordination as its main function to enlist the active and widespread cooperation of all concerned throughout the province and beyond its boundaries. Equally, we feel that the Water Authority in a small province like New Brunswick should not centralize its activities, but should encourage the sense of local initiative and practical approach to problems of water supply and stream pollution on the part of the various interests throughout the province. Therefore, we do not propose to design, construct, or operate any large projects.

This raises the question of technical aid on special problems of water supply and pollution. The federal government provides very valuable services for the asking, and perhaps the time has come for the smaller provinces to request a panel of experts who could be available for consultation on difficult problems. One example in New Brunswick is the wide-spread occurrence of iron, manganese and salt in ground water wells, which suggests geological surveys. Another is the elusive problem of reducing the heavy silting of various inland rivers by erosion from farms and forests, which has some relation to the impressive work of maritime marshland rehabilitation of the federal Department of Agriculture. From time to time in the industrial field the control of oil, phenols, cyanides, and numerous other chemicals calls for experience beyond the scope of any provincial authority. At this point we in New Brunswick would like to pay further tribute to the Ontario water resources commission for their courtesy in sharing their special findings. Private consultants have their place in relation to such problems, but in Canada there appears to be a service function which might be fulfilled to best advantage by the federal government. The next remark is mainly my own. On the other hand, we are not sure that the federal government should be pressurized to share the financial costs of water and sewage works except in special cases of national concern, because federal money has to come from all parts of the country in any case and works of this kind are fairly well distributed according to population with little need for selective assistance.

New Brunswick offers a form of financial aid which is unsual in Canada. There is no formula for water supply projects, and it is obvious that commercial establishments should bear their full share of both water and sewage costs. The particular move was made with the aim of speeding up the treatment of domestic sewage by municipalities in the campaign for cleaning up our rivers. The provincial government guarantees the approved capital investment for both sewers and sewage treatment works. In addition, the municipality each year for thirty years is paid a sum equal to half the interest on the initial capital investment for collector sewers and approved equipment for sewage treatment. In other words the Government is not as a rule out of pocket in guaranteeing the municipality's loan for both sewers and sewage treatment, but is so for sewage treatment. If the amount for the sewage connection and treatment is $50,000 which the municipalities spend, multiply by half the interest rate of the loan at let us say 6 per cent; then $50,000 at 3 per cent is $1,500 per year that the Government will pay the municipality every year for 30 years. In other words in 30 years the Government has paid practically the equivalent of the capital investment, but not the amortization. We are glad to have a formula, so that we get away from the embarrassment of dealing with individual grants. Any other financial support by the Provincial Government would be based on full repayment with interest—which is the only formula for water and sewage works in most provinces.

The story of water supplies throughout New Brunswick is an interesting one, but this is not the place for details. It is rather surprising that along the whole course of the magnificent Saint John river nearly every supply is drawn from wells, mainly because the municipalities are not very large. It is quite true that ground water is cool throughout the year and usually does not require filtering or strong chlorination, but such water is often too hard and many sources are too high in content of harmful minerals. On account of increasing proportions of salt, iron, and manganese in deep wells at Camp Gagetown—those are two wells of one million gallons each—a change to the Saint John river is under way at great expense without enthusiasm. Large users, such as the pulp mills, of course have to draw from rivers and lakes, choosing water as clear and as pure as possible. The city of Saint John and certain other communities are highly favoured by supplies of water almost perfect in quality with flow by gravity from impounding lakes.

In general, New Brunswick is very fortunate with its water supply potentials, but each area has its own particular problems with surface water and ground water and with the economic factors in thinly-settled sections.

Water once used goes back into circulation. It is the inherent responsibility of each user to treat the effluent or at least to ensure that the receiving streams will be kept in sweet condition, not only for subsequent use by others but also for the general health, welfare, and respectability of all the people. Although conditions in general are not yet serious, it must be admitted that sanitation in New Brunswick is not yet something to be proud of. Only one community, Shediac, has a municipal sewage treatment plant. Another is going in for Renforth and Kennebecasis Park on beautiful Kennebecasis Bay, based on the modern stabilization pond to give complete treatment by natural means without chemicals at very low operating cost, and this appears to be a promising development for a province like New Brunswick with flat lands to spare, and where we have on the average 30 acres of land per capita.

The Department of National Defence installed large and elaborate mechanical plants at Camp Gagetown, Chatham Airport, and St. Margarets, the first serving also the associated town of Oromocto. The provincial hospital in Campbellton has an activated sludge plant. Septic tanks are the answer for householders in thinly-settled areas, but community systems are coming more and more into the picture. In too many places along the great stretches of seashore the municipalities and individuals are discharging untreated sewage which has resulted in the closure of shellfish beds by federal agencies.

Pollution by industry is another matter and covers a wide range. Commercial plants are in business for profit, and must be expected to bear the full cost of both water supply and subsequent treatment, whether isolated or within a community system. The largest units in New Brunswick are the pulp mills and the quantities of waste are enormous, particularly in terms of dissolved organic and inorganic substances in the effluents. Fortunately, most of the mills are on seaboard, and at least it can be said that the waste water does not affect other users. In two cases the effluents discharge into international boundary stretches of rivers, and point to the aim of installing equipment for retreatment at high capital investment in the hope of recovering values to counterbalance the extra cost.

On the Saint John river one of the three potato starch factories has installed equipment to manufacture cattle food from its own waste, along with the same material trucked from two similar plants across the international boundary. The State of Maine has introduced a regulation requiring potato starch plants to recover harmful discharges, which now pollute three rivers crossing the border to the Saint John river.

Control measures have been instituted in conjunction with federal authorities to reduce pollution from the new oil refinery in Saint John harbour, with the objective of protecting the fisheries and the general sanitation in the area. More measures will have to be taken to control pollution from many small industries throughout the province as time goes on.

In addition to domestic and industrial wastes, the silting of streams is looked upon as another serious source of pollution. Particularly on stretches of the Saint John river this is a pressing problem. Better farming practice is called for to save the valuable soil at its source. Too much silt is eroded from forestlands and roadways. The approach to this problem is something for special consideration. We would like you gentlemen to think about allocating the Maritime Marshlands Rehabilitation organization to the service of the four Atlantic provinces in order to extend their services in relation to the widespread problem of silt and what we should do about it.

Broadly, it should be emphasized at this point that pollution should be handled on land at its source, and not be left for mopping-up in the streams. There is no reason why the beautiful rivers of the province cannot be kept in clean condition for fish and wildlife, bathing, boating, and water supply, as well as power development, navigation, log driving, and all the other multiple uses which nature intended. Citizens have not been reminded forceably enough that clean water is just as much a sign of civilization as TV sets.

The Saint John river board is completing its study of present and potential power developments in the whole watershed. The water conditions with dams at Grand Falls and Beechwood on the main river and at Tobique on one large tributary are reasonably well understood, and further tests each year will establish the quality base of the water. Estimates have been made of changes when three more dams are built and precautions will be taken accordingly. Some changes will be for the better and others for the worse, but in general it seems possible to preserve the natural characteristics of this great river for use and enjoyment by all concerned. The prospect is that the Miramichi, the Restigouche, and the other famous rivers of New Brunswick can remain in their natural state if protected by pollution control before discharge of effluents.

In conclusion, it can be said that the New Brunswick Water Authority has taken a good look at the present situation in the province and can see the general course to be followed in future. Preliminary surveys have been made of water quality in the main rivers and coastal shorelines. In certain districts studies of water supplies and pollution control measures are in progress. Other departments for a longer time have been dealing with certain aspects of the same general problem. Federal agencies have local staffs who are continuing their efforts along the same line and are welcoming the prospect of provincial action to correct the troubles. Local bodies are fitting into the scheme of things for a combined effort to take advantage of the wonderful natural assets with which the province is endowed. This is all part of a national movement, and New Brunswick is glad to have its full share in maintaining a better way of life by keeping our rivers clean.

I have added a few paragraphs here, with diffidence, regarding the other three provinces.

*Newfoundland*

The population is 460,000 and the area of the Island approximately 43,000 square miles (Labrador 113,000 square miles additional).

The problems of water use and pollution in Newfoundland are akin to those in New Brunswick, though probably less pressing. In both provinces most of the people live on or near the coast. Newfoundland has few inland centres of

population and industrial development. Both provinces receive relatively heavy precipitation and there is an abundance of fresh water.

Forest products and mining are two of the major resource industries, with agriculture being much less extensive in Newfoundland than in New Brunswick. In both provinces, too, the Atlantic salmon is a most important and very welcome visitor.

Nineteen communities on the island have both water and sewer facilities. A few others have either one or the other of these utilities. However, there are 50 communities which have neither piped water nor sewers. As yet, there are no sewage treatment plants in Newfoundland, unless these be at United States military establishments.

The Wild Life Act, the Crown Lands Act, and the Waste Material (Disposal) Act, 1956, all contain provisions for the protection of inland waters and, of course, the federal Fisheries Act applies as elsewhere in Canada.

The Symposium on Water Resources in St. John's, May 4-5, indicated a growing interest by government in a concerted effort to bring water supply and pollution under organized control.

*Nova Scotia*

The relatively large population of 725,000 occupies some 21,000 square miles. In most respects the water conditions are like those in New Brunswick and Newfoundland.

Water supplies come mainly from wells, but a number of cities and towns have reservoirs for surface water. The pulpmills take water from rivers and lakes. As is the case throughout the Atlantic Provinces, there are ample supplies of pure, clean water in most locations.

The Halifax sewers discharge wherever convenient into the harbour and the famous North West Arm. Nearly all the other centres also are on seaboard with sewers flowing to channels or river mouths. Although to date no municipality has a sewage treatment system, several plans are said to be in hand. The Department of National Defence operates a mechanical treatment plant at Greenwood. There has been little word of a sanitation program in Nova Scotia, but it can be expected that regulations and control will not be delayed much longer.

Legislation already has a wide coverage. The Water Act, Chapter 312, 1954, vests in the Crown sweeping jurisdiction over all the water courses in the province. The Lands and Forests Act, Chapter 145, 1954, the Public Health Act, Chapter 234, 1954, and the Ditches and Water Courses Act, Chapter 73, relate to other phases of water and sewage control.

*Prince Edward Island:*

I was over there a week ago and was very pleased with the situation.

The Island has a relatively small problem, as the population is only 105,000 and the area 2,000 square miles. The Department of Health is taking a keen interest in plans and in enforcement of regulations since the recent passing of permissive legislation.

Water supplies are entirely from wells and without reservoirs, as surface water for the purpose is limited and variable. The few larger municipalities have deep wells yielding fairly hard water. The smaller communities have softer water from shallow wells. The many individual householders rely on their own shallow wells.

Pollution control has advanced during the past three or four years, and Prince Edward Island may be the first of the four Atlantic Provinces to complete the works. The alluvial silt soil without gravel and rock is not favourable for

large septic tanks, but the ease of bulldozing and the wide-spread areas of flat land point to stabilization ponds—oxidation ponds and sewage lagoons; they have half a dozen names—as the economic answer for complete treatment of domestic sewage by natural means. At a number of locations it seems sufficient to discharge sewage well out into strong ocean currents. Scattered householders as a rule have their own small septic tanks. The small community of O'Leary provided a 2-acre lagoon two years ago and the larger community of Kensington a 6-acre lagoon last year, both operating perfectly at minimum cost. One can hardly believe how simple they are to build and how little they cost to run per year to give perfect treatment. A test of water overflowing from one of them the other day was found to be class B. Some of the wells are class C and D. It shows what nature can do if you give it a chance. Charlottetown and Parkdale discharge sewage through long outfalls into seaboard channels for adequate dilution. Summerside has a more difficult problem, which may be solved by similar action. The R.C.A.F. station near Summerside has a primary mechanical plant with chlorination of effluent before discharge into Malpeque bay. Other communities are studying plans for sewage treatment in collaboration with the Department of Health, the federal departments of Fisheries and National Health, and various consultants. Although contamination is serious in many instances, the program of control seems to be advancing rapidly. Everywhere the federal authorities establish orthodox mechanical plants at high cost, whereas we in the Atlantic Provinces have to use ingenuity to get better money's worth.

The CHAIRMAN: Gentlemen, if you have any questions of Dr. Bates, we will have them now.

Mr. MACRAE: From what Dr. Bates has said, it would seem that because of vision on the part of past New Brunswick governments this province seems to be well advanced in its approach to this problem, and we have heard a great deal about it.

It would seem, though, that the cities—and there are six New Brunswick cities today—have been rather tardy in their approach to treatment of sewage, because there is not a single New Brunswick city that treats its sewage today, is there?

Dr. BATES: Not a single one.

Mr. MACRAE: That is not a very good record, is it?

Dr. BATES: I might say, we were invited the other day to a Kennebecasis bay annual meeting. The communities above the proposed sewage lagoon are asking what we are going to do. Their choice will be to treat their sewage or to be served an injunction.

They asked, "What does the city of Fredericton do?", I said, "It dumps the sewage into the Saint John river in front of the city". That was a big laugh. We thought about dealing with Fredericton first and making it an example, and decided against it, because people would say, "You can do that in a capital city, but it would not work elsewhere in the province".

Mr. MACRAE: You mentioned that the pulpmills, with one exception, were all built prior to the passing of the 1936 act. I believe the only one built since then was the mill at Miramichi.

Dr. BATES: The legislation was in 1956.

Mr. MACRAE: I am sorry; 1956. Was there any difference, in the Miramichi treatment of its raw waste, from the mills at Campbellton and Bathurst, and so on? Are they still doing the same thing, dumping it into the river?

Dr. BATES: The Miramichi plant is a kraft pulpmill built to save the chemicals, and therefore it is the type of mill that has the minimum harmful discharge.

Mr. MACRAE: It is not serious in Newcastle?

Dr. BATES: If they ever put in a bleaching plant, it would make it that much worse. The ordinary type of sulphite mills are wide open and everything goes to waste.

Mr. MACRAE: You mentioned that, chiefly because of these mills, and also because of raw sewage, there has resulted the closure of shellfish beds, and so on.

In your opinion, does that have any effect on salmon in the Saint John river and the Miramichi river—the raw waste from these mills?

Dr. BATES: Let us put it the other way around. It is a fact established by the federal agencies, that for miles and miles—too many shellfish beds are closed now. You can argue, why? I believe it is from pollution on shore. Federal agencies cannot step on shore. So we will have to use measures to control the pollution at its source on shore, and we are sure the federal agencies will be pleased.

Mr. ROBICHAUD: Mr. Chairman, I would like to ask Dr. Bates a question. Dr. Bates, you mentioned that in 1958 New Brunswick introduced the New Brunswick water board. How does this control in New Brunswick compare with other provinces? Is it ahead of other provinces, or is it on a similar scale?

Dr. BATES: We have not studied all provinces. Ontario organized a few years ago with a big organization and is proceeding at a rapid rate to make up for lost time with very wide jurisdiction, including far more centralization of authority than would suit New Brunswick. I am sure that other provinces would say the same thing. That is because the conditions are different: they have waited decades—too long—to do this job in Ontario, so why blame them for being tough now?

Mr. Chairman, you probably can speak for British Columbia. There are some controls that are so far away from us that we have not studied them carefully. In New Brunswick perhaps we are second on the list of provinces to do something in this organized way.

Mr. ROBICHAUD: I was also pleased to hear you mention that New Brunswick needed technical aid and was taking steps to get assistance, particularly in the federal field.

There must have been consultation with experts in the mineral field, which you also mentioned. Do you know of any practical results from such consultation?

Dr. BATES: I am not quite clear about your reference to the mineral field.

Mr. ROBICHAUD: You mentioned that New Brunswick needed technical aid from the experts.

Dr. BATES: I was talking about water problems.

Mr. ROBICHAUD: I thought you mentioned also that at one time they were doing it in the mineral field as well.

Dr. BATES: If I were in charge of something that had to do with minerals in New Brunswick, I would do the same as we have done with the water authority, hunt up in Ottawa what federal agencies could help.

We have had tremendous help from all the federal agencies, and that is one thing I wanted to bring out at this meeting. On the other hand I am about the last one to pester the federal government to spend more money except for very special things—in other words, not for ordinary bricks and mortar. We have found out that a small province such as New Brunswick cannot have an expert organization to cover every phase of water resources and pollution control. I would say that applies to every province in Canada except Ontario, and maybe Quebec. You could easily say, "Leave it to consultants", but it is

like finding the right doctor when you are sick. Here is a place, with a slight extension of service, for the federal departments.

Mr. ROBICHAUD: You mean, technical service?

Dr. BATES: Yes, technical only—to advise and give guidance.

Mr. ROBICHAUD: You also mentioned that the town of Shediac is the only community in New Brunswick which has a sewage disposal plant. I understand the main reason which led the town of Shediac to build such a plant was because of the closing of the shellfish beds in the area.

Mr. MacRae mentioned the fish life in the Saint John river. In the Saint John river I think there is only one pulpmill in the upper section of the river, the one at Edmundston, and I am led to believe that the pulpmill may have very little effect on the pollution of the Saint John river. Just the same, do you have any concrete evidence that pollution has had some effect on the fish life in the Saint John river?

Dr. BATES: The biggest pollution, of course, is from Edmundston, from a wide-open pulpmill. The only way to do is as they are doing, studying how to make a closed system and lose as little money as possible by so doing; or make a profit, if they can, on capital investment.

I would say that after all these years the stretch of river down to Grand Falls—which is 30 miles or so—is an open sewer, good for nothing except to carry some water; and it is too much polluted to even clean it up.

Mr. ROBICHAUD: Is pollution not also accelerated by the fact that the Saint John river has such a difference in levels? In the summer time the water gets very low, and it is easier to be polluted than if the water were at a higher level?

Dr. BATES: Let us finish with that pulpmill. The effect is serious to Grand Falls, which largely purifies the river at the point by oxidation.

We are talking about a big river that purifies itself, passes on, and a lot of people think that it is not too bad.

There is another pulpmill at the very mouth of the river at the Reversing Falls in Saint John where there is such dilution and turbulence that nobody has been able to find out whether or not it has affected fish. If it were a trickle of water, it would be terrible. But we are talking about a drainage area at that point of the Saint John river is almost equivalent to the whole area of New Brunswick; 20,000 square miles of drainage area in the Saint John river.

That is why we do not look on the pollution from that pulpmill as being nearly in the same class as the mill up at Edmundston. That one has got to be corrected.

The CHAIRMAN: Mr. Robichaud, I wonder if it would be agreeable if we heard from Mr. Tweeddale now, because we are going to be rather short of time. It may be the wish of the committee to have a meeting later this afternoon, to hear further from these witnesses. But if we could hear from Mr. Tweeddale on the work of the Saint John river board and the problems, we would appreciate it.

Mr. R. E. TWEEDDALE (*Manager, New Brunswick Power Commission*): Mr. Clark, the chairman of the Saint John river board, has that information, Mr. Chairman.

The CHAIRMAN: Mr. Clark, then, please.

Mr. R. H. CLARK (*Chairman, Saint John River Board*): Thank you, gentlemen. I propose to outline to you today the activities of the Saint John river board—what it has done and what it is doing in its study of the effects

of storage on the upper Saint John river on the existing and potential power developments in New Brunswick.

The Saint John river board was established effective August 1, 1958, and I will have copies of the terms of reference distributed to you. The terms of reference specify that the report of the board must be submitted by June 30 of this year, and we are now engaged in reviewing the results of the studies and in drafting a report. As a matter of interest, we have recessed the eleventh meeting of the board in order to appear before you this morning.

I would like to give you just a little background leading up to the formation of the board. It was in August, 1956, that the governments of Canada and the United States requested the International Joint Commission to estimate the cost of developing the international tidal potential at Passamaquoddy bay in Maine and New Brunswick and to determine whether such cost would allow hydro-electric power to be developed at a price which would be economically feasible. The international Passamaquoddy engineering board was established by the International Joint Commission to carry out these studies.

A characteristic of all tidal projects is the generation of substantial amounts of secondary power which must be supplemented with auxiliary sources of power in order to meet utility loads. The Passamaquoddy engineering board examined a number of sources of power in order to firm up the Passamaquoddy project. The board concluded that a storage and power development in the vicinity of Rankin rapids on the upper Saint John river, in the State of Maine, would combine favourably with the tidal power project and yield the lowest energy and power costs for such a combination.

Apart from tidal projects, the hydro-electric power potential in New Brunswick is located primarily on the Saint John river. The total economic potential of the Saint John river in New Brunswick is of the order of 900,000 kilowatts, and the development of storage and power at Rankin rapids, as you can see, would have a significant effect on this potential.

The Passamaquoddy engineering Board examined only the effects of Rankin rapids storage on the existing developments at Grand Falls and Beechwood, both of which are in New Brunswick. It was primarily to study the storage effects on all developments, both existing and proposed, that the federal and provincial governments established the Saint John River Board—to determine the effects of this storage on the existing as well as on the potential developments in New Brunswick.

I think it would be pertinent if we looked at the board's terms of reference at this time, which will give you a little background and will explain how the board was to operate. I will not read them in detail, but I will read the pertinent sections:

> Whereas the international Passamaquoddy engineering board is at present studying possible power developments and large storage reservoirs located on the Upper Saint John River, as well as the effect that such a development might have on the potential power output of the proposed Passamaquoddy tidal project;
>
> Whereas it is desirable and in the public interest to determine the effect on river flows, and on existing and potential power developments and on the other water uses in New Brunswick of storage possibilities in the Saint John river basin with particular reference to storage on the upper Saint John river and its tributaries when operated primarily for:
>
> (*a*) maximum at-site power production,
>
> (*b*) maximum basin power production,
>
> (c) firming Passamaquoddy tidal power output;

The two governments agreed to set up a board, effective August 1, with two members for Canada and two for New Brunswick. The appropriate section regarding the chairman reads:

> The Chairman of the Board shall, for the first six months, be a member for Canada. The chairmanship shall rotate thereafter every six months between a member for New Brunswick and a member for Canada.

Clauses 4 and 5 are the most important. They give the directives as to the scope of the studies the board shall plan, supervise, and carry out. Clause 4 says:

> 4. The board shall plan, supervise, and carry out an investigation to determine how the present and future power developments in New Brunswick would be affected by the development and operation of storage on the upper Saint John river and its tributaries.

Then, clause 5:

> 5. In carrying out this investigation the board shall consider the comparative benefits to be derived by New Brunswick from:
>
> (*a*) the proposed integrated Passamaquoddy-Saint John river developments;
>
> (*b*) the integrated Saint John river development with the exclusion of the tidal project should energy from tides prove too clostly;
>
> (*c*) further interconnections and pool operation of adjoining transmission systems.
>
> The board shall also consider the effects of the said power developments on the other potential water uses of the Saint John river basin.
>
> 6. The board may submit interim reports to the two governments but, at all events, shall render a final report on its findings not later than 30 June 1960.
>
> 7. The board shall be terminated within a period of three months from the submission of the final report unless the governments otherwise direct.
>
> 8. Work under this reference does not include field investigations for establishing physical aspects of existing or potential power sites in New Brunswick.
>
> 9. Canada and New Brunswick shall share equally the cost of the said investigation and report. They shall provide, on an equal basis, the funds necessary for the general expenses of the board and for the work authorized by the board and carried out especially in the interest of its investigation, as distinct from work normally carried out by the departments of government co-operating with the Board.
>
> 10. In conducting its investigations and performing its duties, the board may utilize the services of engineers, specialists, and other employees of the public services of Canada and New Brunswick. It may call on government departments to conduct studies and to provide information which may require the formation of departmental or interdepartmental committees. The board shall make all possible use of existing reports, information and technical data and also any that may become available during the course of its investigations, in order to avoid unnecessary expense and duplication of effort.
>
> 11. In addition to the federal and provincial employees referred to in paragraph 10 above, the board may employ an executive officer and such engineers, specialists or other personnel as it may deem necessary and it

may incur such other expenses as may be required for the purposes designated and pay for the same out of funds appropriated therefor.

This agreement was signed on March 24, 1959.

Before I outline the course which the board took in its studies, I would like to describe very briefly the Saint John river and its characteristics. The Saint John river is one of the largest North American rivers discharging directly into the Atlantic ocean. It has a drainage area of about 21,300 square miles at Reversing Falls, of which about 51.4 per cent lies in New Brunswick, 12.9 per cent in the province of Quebec, and 35.7 per cent in the State of Maine. A large part of the drainage area in New Brunswick is tributary to the Saint John river in its lower reaches, so that if we consider the drainage area at Beechwood, for example, which totals 13,000 square miles, only 27 per cent is in New Brunswick and about 51 per cent lies in Maine.

The international character of the river, therefore, is quite apparent. The boundary between Canada and the United States follows the main stem of the Saint John river from its headwaters in Little Saint John lake, a distance of about 30 miles, and also for a distance of 75 miles between St. Francis, Maine, and Grand Falls, New Brunswick. The St. Francis river, a tributary of the Saint John, forms the international boundary for an additional 27 miles.

From its origin in Little Saint John lake to tidewater at about Fredericton, the river is approximately 435 miles long and falls a distance of 1,578 feet. Only 185 feet of the total potential head is at present utilized at the hydro generating stations at Grand Falls and Beechwood, both of these developments being in New Brunswick. There remain about 242 feet of undeveloped head in New Brunswick which can be considered as being available in three reaches: first, that between Grand Falls and Beechwood, in which there is a fall of about 58 feet; second, that between Beechwood and Woodstock, in which there is a fall of about 74 feet; and, third, that between Woodstock and tidehead, in which there is a drop of about 110 feet.

The development of the head in these reaches was investigated and reported upon by the international Saint John river engineering board in 1953. However, as a result of more detailed field information supplied by the New Brunswick electric power commission, we have been able to assess these possibilities more thoroughly and to provide firmer cost estimates of developing these reaches.

Although there are numerous lakes in the headwater regions of the Saint John river, and although storage on some of them has been developed for log driving purposes, the effect of these natural storages on the flows of the Saint John river has been small. This is evident from the 42 years of flow record at the Pokiok gauge, where the monthly flow has varied from a minimum of something less than 3,000 cubic feet per second to a maximum of about 140,000 cubic feet per second, roughly 50 times the minimum. It is apparent, therefore, that the development of storage in the basin could have significant effects on any power developments on the river.

At the present time there is only about 391,000 acre feet of storage developed but this could give a moderate flow increase which can be illustrated by considering the flows at the Beechwood development. During the driest period of record, flows at the Beechwood site for the months of January, February and March averaged 3,050 cfs. By utilizing the entire volume of live storage at present available—that is, the 391,000 acre feet—this flow could have been increased by 2,170 cfs to an average of 5,220 cfs.

The importance, therefore, of the proposed Rankin Rapids reservoir with a live storage volume of 2.8 million acre feet is apparent. The development of

this storage and the at-site power is economical and could raise the minimum flow in the Saint John river at Rankin Rapids from about 550 cfs to about 6,000 cfs and an equivalent amount at Beechwood.

In the course of its studies the board made a thorough investigation of the hydrology of the river to determine its flood potential in order to arrive at flow figures for the design of spillways of proposed developments and in order to estimate the amount of energy which could be generated by hydro developments.

To provide specific answers to the terms of reference, particularly clauses 4 and 5—and, we might look at those again: to determine how the present and future power developments in New Brunswick would be affected by the development and operation of storage on the upper Saint John river and its tributaries; and to determine the comparative benefits to be derived by New Brunswick from those three items in clause 5—we considered that the most satisfactory method for evaluating the effects of upstream storage on present and future power generation in New Brunswick was to compare probable sequences of power development in the province, with and without the storage and with and without exchange of energy with adjacent systems. Studies of this type are very complex, and there are literally millions of computations to be made if all factors are to be considered and their interrelationship determined. The board, therefore, utilized an electronic computer and hired H. S. Gellman and Company, data processing consultants, Toronto to prepare the computer program. The technical studies of the board are being carried out by H. G. Acres and Company Limited, consulting engineers, Niagara Falls, with assistance from engineers of the New Brunswick Electric Power Commission.

The effects of the storages and proposed power developments on the river on the other water uses such as fisheries, recreation, pollution, navigation and flood control will be shown in the report.

In this respect, we have asked assistance from the federal Department of Fisheries, the Department of National Health and Welfare, and Dr. Bates' organization, the New Brunswick water authority, to provide us with assessments of the proposed developments on these uses.

The CHAIRMAN: Thank you, Mr. Clark. Are there any questions?

Mr. MACRAE: Mr. Chairman, I have one or two brief questions.

You mentioned that the power potential of the Saint John river was 900,000. How much is presently being generated? What is the total on the Saint John river?

Mr. CLARK: 132,000 kilowatts.

Mr. MACRAE: And, with the further projection at Beechwood, when it is needed later on?

Mr. CLARK: 36,000 kilowatts.

Mr. MACRAE: I have one other brief question. You mentioned Passamaquoddy—and I presume that is not within your province here—but the international Passamaquoddy engineering board brought down its findings, and said: Passamaquoddy is not economically feasible at this time. Is that correct?

Mr. CLARK: That is the conclusion in so far as Canada is concerned.

Mr. MACRAE: So far as Canada is concerned?

Mr. CLARK: May I read that conclusion? It is conclusion 12 of the Passamaquoddy report, which says:

> Assuming an equal division of power output and fixed cost, between the United States and Canada, construction of the tidal power project with all of Rankin Rapids as auxiliary, is not an economically justified project for Canada.

Mr. MACRAE: At this time?

Mr. CLARK: No.

Mr. MACRAE: It is just not, period.

Mr. ROBICHAUD: Mr. Clark, the terms of reference mentioned that the expenditures of this board will be shared equally by the federal government and the province of New Brunswick. Do you know what has been the total expenditure to date?

Mr. CLARK: Until the end of March, the total expenditures were about $204,091.

Mr. ROBICHAUD: Were those expenditures mostly concerned with technical advice from consulting engineers or consulting firms?

Mr. CLARK: The studies were carried out by a consulting firm. The majority, or the largest part of that total expenditure is to H. G. Acres and company.

Mr. ROBICHAUD: Are the salaries of the members of the board, who are already employees of the federal or provincial government, included in those expenditures?

Mr. CLARK: In these expenditures, we have received technical assistance from the New Brunswick power commission and, in those instances where they are working directly on board work, the board pays the power commission.

Mr. ROBICHAUD: Is it the same rate of salary they are getting from the New Brunswick government?

Mr. CLARK: Yes.

Mr. ROBICHAUD: Plus travelling expenses?

Mr. CLARK: Yes.

Mr. STEARNS: Mr. Clark, you stated a moment ago that as far as Passamaquoddy was concerned, it was not economical, as far as Canada was concerned. How about Rankin Rapids? Is that considered economical?

Mr. CLARK: It is considered economical, but the two were proposed by the Passamaquoddy board as a unit.

Mr. STEARNS: Well, in the event that Passamaquoddy is not ready to go ahead, it is still the intention of the province to build a storage at Rankin Rapids.

Mr. CLARK: Rankin Rapids is in Maine, and we were interested in the effects of Rankin Rapids.

Mr. STEARNS: Is all that stretch of the river in Maine?

Mr. CLARK: Yes.

Mr. STEARNS: St. Francis is a boundary?

Mr. CLARK: Yes. The boundary comes down here.

Mr. STEARNS: So, to improve the flow of the Saint John river, you would have to go to the United States, to start the ball rolling, and to build any development at Rankin Rapids?

Mr. CLARK: There is a substantial amount of storage here. There is 2.8 million acre-feet. There is 391,000 acre-feet developed in the tributaries here—Madawaska, the Tobique, which is entirely in New Brunswick, and the Aroostook. There are other possible storage developments, but they are small.

Mr. ROBICHAUD: Mr. Chairman, I have another question, and I do not know whether I should direct it to Mr. Clark, or to Mr. Tweeddale.

As we all know, one of the main problems of the development of the Saint John river, is the settlement of the water storage problem. It has been a long one. I have here a report on the Saint John river water storage commission that was established in 1909. It sat from then until 1916. According to this report, certain recommendations were made at the time, after consultation with the state of Maine and the province of Quebec.

Could we have a report on the present standing of the water storage problem of the Saint John river?

Mr. TWEEDDALE: Mr. Robichaud, the study in 1909 was made primarily at the request of log driving authorities. At that time lumber was cut in the Maine area, and driven down to Saint John, where saw mills were located. A great deal of trouble was experienced with the log drives in these various stretches of the river. The study was to create storage in these various lakes in Maine, which would assist this log driving. Then, of course, there was the International Joint Commission's study which Mr. Clark mentioned, which presented its report in 1953. This study on storage was primarily to do with the effects on power aspects. Then the present study of the Saint John river board, which Mr. Clark was mentioning, was brought into being primarily to study the effects of the larger storage at Rankin Rapids, in view of the fact that this was being discussed by the United States in connection with Passamaquoddy.

At the same time, of course, the effects of the smaller studies were brought up to date from the I.J.C. study and re-assessed. Does that answer your question?

Mr. ROBICHAUD: It answers part of my question. But what I am mainly interested in is this: what stage are we at now, as far as the possibilities of adding to the storage of the Saint John river, which would be required for future power developments on the river?

Mr. TWEEDDALE: There are no direct negotiations under way at the present time with the United States, as far as the Rankin Rapids storage is concerned. Of course, the outcome of the board would put us in a better position to know what we are talking about when negotiations are started. There is one thing, of course, that I think should be emphasized, and that is the fact that Rankin Rapids is not only a storage site, but it is a very major power site as well; and is one of the cheapest power sites available in the State of Maine at the present time. So there is incentive there for the State of Maine in the United States to develop this power site for its own uses. Then, of course, the downstream benefits from the storage aspect would accrue to New Brunswick, whatever they were. This is what we are endeavouring to determine in the board's study.

Mr. ROBICHAUD: Now that Mr. Tweeddale has given us the aspects as far as the United States is concerned, how do we stand with the province of Quebec, because I understand that the province of Quebec will have a major effect on any additional storage that would be required for the Saint John river established from Lake Temiscouata and all that region, which is quite settled all along that lake, and the Madawaska river?

Mr. TWEEDDALE: Just before that, I would mention this, if I may. The proposed installed capacity at Rankin Rapids has not been mentioned, and it is 460,000 kilowatts; and the 900,000 which Mr. Clark mentioned is entirely in New Brunswick. I just wanted to qualify that point.

In connection with Quebec, the cheapest storage available in the system is Lake Squatec, which flows into the Temiscouata. There is no development around it, and it is an economic storage. As Mr. Clark pointed out, the developments around Temiscouata—no, Mr. Clark did not; somebody mentioned it a moment ago—makes it very expensive for further development at Temiscouata.

The next most economic storage in Quebec, or affecting part of Quebec, is the glacier lake system of the St. Francis. This would cause a certain amount of flood damage at the village of Rivière Bleue, in this area. It has international aspects as well, and would affect New Brunswick, Maine and Quebec.

The other smaller storages are not too effective because of the small drainage areas, as can be seen from this map, and the effect on the flow would be relatively small.

Mr. ROBICHAUD: Thank you.

Mr. MACRAE: Why has Maine not developed anything at Rankin Rapids yet? Is it just that there is no market, no close market for their power; is that the principal reason?

Mr. TWEEDDALE: I assume, Mr. MacRae, that this is one reason why it has not been developed in the past. One, of course, is the magnitude of the development. I believe the estimated cost is $140 million. It is a 300 foot dam, with very large flooding damage. Of course, this is all woodlands area. And also there is its remoteness from Bangor, Portland, and built-up areas, which requires quite extensive transmission facilities to get it to market.

The CHAIRMAN: If there are no further questions, gentlemen, I suggest that we adjourn. It is now 11:00 o'clock, and I understand this room is required for another committee meeting.

Mr. SIMPSON: What would the distance be from that proposed power development down to Bangor—the transmission distance?

Mr. TWEEDDALE: I believe that in a direct route it is about 160 miles, or 175—in that order.

Mr. STEARNS: Could they not use any of that power at the Great Northern Power Mills?

Mr. TWEEDDALE: I do not believe so, because it would not be steady enough in its output. It would fit into a utility system much better than an industrial power system.

The CHAIRMAN: I wish to thank the witnesses, on behalf of the committee, and tell them how much we appreciate their coming down here to be before us. I am sure we have all enjoyed their presentations and have learned something from them about the problems of the Saint John river. Thank you very much.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 13

TUESDAY, MAY 24, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESS:

Mr. T. M. Patterson, Director, Water Resources Branch, Department of Northern Affairs and National Resources.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23125-8—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.,

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, May 24, 1960.
(14)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Doucett, Gundlock, Kindt, Leduc, Martel, Martin (*Timmins*), McFarlane, McQuillan, Payne, Simpson, and Stearns. (12)

*In attendance: From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; T. M. Patterson, Director, Water Resources Branch; J. D. McLeod, Chief Engineer, Water Resources Branch; R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Mr. Patterson, and he made an extensive statement dealing with some typical responsibilities of the Water Resources Branch in connection with national and international water use problems, and was questioned thereon.

During his presentation, Mr. Patterson emphasized various points by referring to wall maps.

*Agreed*—That an answer to a question asked by Mr. Murphy on May 9th with respect to the number of convictions against persons discharging oil or other wastes into harbours, be printed as an appendix to this day's evidence. (*See Appendix "A"*).

At 11.00 a.m., the Committee adjourned until 11.00 a.m. Monday, May 30.

M. Slack,
*Clerk of the Committee.*



23125-8—1½

# EVIDENCE

TUESDAY, May 24, 1960.

The CHAIRMAN: Gentlemen, we have a quorum.

We have with us again today, Mr. Patterson, who will discuss some typical responsibilities of the water resources branch in connection with national and international water use problems.

Mr. Patterson, will you proceed to discuss this question?

Mr. T. M. PATTERSON (*Director, Water Resources Branch, Department of Northern Affairs and National Resources*): Thank you, Mr. Chairman.

Mr. Chairman and gentlemen of the committee:

I appear before you in a "pinch hitter" capacity again today. When word that the arranged schedule of appearances had broken down came at the end of last week it seemed appropriate that I should take over with a further outline of some of the work for which the water resources branch is directly responsible. I feel that I owe it to your committee, to my branch and to myself to have undertaken today's presentation on a less impromptu but better prepared basis. However, I hope that what I have to present will provide you with some additional understanding of the types of problems to which the branch itself applies the hydrometric data it collects through its district offices under cooperative arrangement with the provinces where appropriate. These same basic data in the form of lake and river levels and discharges are made available to the public for a myriad of applications in all water use problems that are posed to municipal, provincial, federal, industrial, farming and private interests. While the expanding nature of the country-wide programme of hydrometric data gathering, processing and publishing requires a corresponding growth in field and office staff, it is in connection with the application of these basic data to the solution of problems and responsibilities directed to the branch in the process of government that there is pressing need for continued growth in technical and senior professional staff and associated services.

I propose to refer to a large number of problems in which the branch is involved and since I may not be the best informed with respect to some of the details of certain of the problems, I have with me a number of our senior engineers and administrative staff to assist in providing you with more detailed information. Some of my references may be to the engineering study stage of subjects involving international relations which in some respects are sub-judice. Accordingly, when it comes to the question period I rely on your judgement to avoid the posing of queries which could involve embarrassment in these matters. I would stress also that while many of my references will be to responsibilities that the Branch has to the international joint commission, it is not my intention to undertake a presentation that might preempt in any way what General McNaughton may wish to cover when he appears before your committee in the near future.

This presentation might be entitled "Some typical responsibilities of the water resources branch in connection with national and international water use problems". In the former connection the committee has had special talks with respect to the Saint John river board and the Fraser river board. In the latter case the answer to some questions of the committee were left outstanding and with your permission, Mr. Chairman, I would like to offer the additional information requested before proceeding.

In my appearance on 3 May I undertook to provide Mr. Payne with information as to the approximate cost of partial development of "System A" if the power phase of it was omitted. This modification of system A would involve the elimination of the two lower sites on the Clearwater river which were strictly power proposals included in the system to provide revenues with which to improve its benefit-cost ratio. By eliminating the cost of these two plants and the cost of the power houses and associated equipment for the five power and storage projects and by reducing the size of the dams and proportioning the flowage costs accordingly it is indicated that the total of the equivalent system A would be approximately 234 million dollars as against the 522 million dollars for the combined system.

System A as presented in the board's report had a benefit-cost ratio of 0.99, i.e. practically unit, based on power revenues only. The elimination of the two strictly power sites on the Clearwater river reduced this benefit-cost ratio to 0.92 and of course the elimination of all power elements from the system eliminates all of the revenues considered in our estimates.

In answer to a further question concerning the change in river level, I would inform the committee that at the town of Mission in the lower Fraser river basin there has been experienced a range in stage on the river of as much as 26 feet between maximum and minimum levels.

It was indicated that the committee would like to have some information presented with respect to the irrigation possibilities in the basin. In answer to that, Mr. Chairman, I do no think I can do better than to read into the record the short section on irrigation as it appears on pages 11 and 12 of Appendix "A" of the board's preliminary report.

In connection with this, the board had the following to say—and this was based, to a large extent, on information which was obtained from the provincial bureau of economics and statistics of the Department of Industrial Development:

> The annual consumption of electricity for irrigation in the province, though presently only 10,000,000 kwh, has doubled since 1950, which indicates a marked trend. (15). It is predicted that more energy will be needed in the future because most of the potentially arable land cannot be cultivated successfully without water, and pumped irrigation will be required because few opportunities for gravity flow remain.
>
> It is shown in table 18, p. 26, that 95 per cent of electrical energy required for pumped irrigation is supplied in the Kamloops load region, the remainder near Vancouver, and none at all around Prince George. The power required for future irrigation has been estimated from the area of potentially irrigable land, the height of lift, the duty of water, and the length of the irrigation season. All these factors have been taken into account in preparing the data for table 19, p. 27, and table 20, p. 27. Also it has been assumed in the estimates that sprinkler rather than furrow irrigation would be used; and that for the areas in census divisions 6 and 8, the average lift from water source to soil would be 200 feet, except for 66,000 acres for which the actual lifts are known from surveys of irrigable areas. (Reference numbers 16, 17, 18, 19, 20). For census divisions 3, 4 and 5 a lift of 50 feet was assumed. This low figure allows for areas which could be irrigated by gravity flow as well as areas which would need pumping.
>
> The estimated optimum usage of over a billion kilowatt-hours (which represents 626,000 horsepower required on the average for three and a quarter months) presupposes that governments would assume

the major share of capital costs in irrigation projects. Similar assumptions underlie the estimates for 1975, but trends in the expansion of irrigation from 1931 to 1956 have also been taken into account. These short term estimates indicate that the acreages developed for irrigation in the Vancouver load region and consequently the associated energy requirements, would most likely be relatively small. Although on Vancouver island some expansion is possible, in the lower Fraser valley little can be expected unless it should prove economical to irrigate existing farmlands. Most of the rich alluvial soils there have already been exploited, and the undeveloped areas lie in uplands where, because of adverse topography and stony soils, agricultural conditions are marginal. The demand for agricultural products would have to be very large to create the expansion suggested by the figures in table 20. The more immediate prospect in this area is that additional cultivation would be offset by the continued encroachment of urban settlement upon agricultural land.

In Kamloops load region, substantial increases in the irrigated area may be expected by 1975 in the Okanagan district, and on unused benches along the Fraser river south of Quesnel and along the Thompson, North Thompson and South Thompson rivers. There are also good possibilities for agricultural expansion in the Pemberton area of the Lillooet river valley. A company by the name of Riverlands Irrigated Farms Limited, a subsidiary of the British Columbia Electric Company Limited, has undertaken an experiment near Lillooet where 400 acres of parched sagebrush land are being irrigated for intensive production of livestock.

It is believed that irrigation by pumping could become an important aid to agriculture in the Prince George load region, and from a long range point of view, energy consumption for irrigation might one day be greatest there. The soils have the chemical and physical properties that fit them for cultivation, but economic conditions will probably militate against the development of many of them for a long time in the future.

That is from Appendix "A" of the preliminary report on flood control and hydro electric power in the Fraser river basin.

I think copies of the report were distributed to all members. However, if some of you have not received the report, the branch will be prepared to supply a copy.

The CHAIRMAN: I believe they were distributed last year. Those of us who were on the committee last year would have a copy. There may be some new members who would wish to have a copy.

Mr. PATTERSON: One of the responsibilities of the Minister of Northern Affairs and National Resources is to advise the Department of External Affairs on international water matters. In this connection, the minister looks to the water resources branch for the technical knowledge and professional know-how on which advice involving hydrological studies and hydrolic design can be based.

The most easterly problem, involving international waters on the Canadian border, has to do with the possibility of developing the power potential of the tides in Passamaquoddy bay, between New Brunswick and Maine, where it is estimated a tidal project could provide a dependable capacity of 95,000 at a peak of 345,000 kilowatts. The average annual energy generation would be 1,843 million kilowatt hours. Passamaquoddy bay is located right in here, just off the Bay of Fundy. The branch first became associated with tidal

power studies in the twenties, when the plans of Dexter P. Cooper, a noted United States engineer—who proposed an international project at Passamaquoddy bay—were reviewed. Later the branch was responsible for obtaining an engineering report on a Canadian proposal for tidal development in the Petitcodiac and the Memramcook estuaries of the Bay of Fundy. This is up in this area here.

In 1948 the branch was represented on an engineering board appointed by the international joint commission to estimate the cost of carrying out a complete study to decide conclusively the engineering and economic feasibility of a large scale international tidal power project in Passamaquoddy and Cobscook bays. This report was completed in 1950, and in 1956 the two federal governments requested the commission to make such a study. The estimate of that first board for the cost amounted to $3,900,000; of which about $300,000 were for a fishery investigation. Subsequently, owing to improved sonic sounding equipment and methods of obtaining underwater information, the estimate was revised downwards, and about $600,000 were eliminated from that estimate.

The branch, through membership on the commission's board, participated in the engineering studies and findings. The studies required the collection and analysis of a great deal of basic hydrometric, topographic and foundation data, along the line of the dam and powerhouse structures. Design and costs of dams and coffer dams, filling and emptying gates, navigation locks, tidal powerhouses and auxiliary power developments, all had to be analysed, and power markets and economic effects were studied.

Throughout the investigation the engineering board maintained liaison with the separate fisheries board, which was appointed to study the effects the project might have on fish life in the area. The reports of both these boards are before the commission at present.

Other tidal power potentialities exist in Canadian waters, particularly in the area of the high tidal variations of the bay of Fundy. There is evidence of increasing public interest in several of these.

The St. Croix river flows into Passamaquoddy bay at this point, and for much of its length it forms the international boundary line between Maine and New Brunswick. The river and man's occupation of it have provided many water problems in which the branch has been involved in international study. An international board of control has functioned on the river since 1916, and the branch has provided the Canadian membership since the early twenties. The board has had responsibilities with respect to power plants, fishways and storage operations; and branch personnel have maintained inspections and have investigated complaints with respect to the flooding of riparian interests.

In 1955 the governments of Canada and the United States asked the international joint commission:

> —to determine whether greater use than is now being made of the waters of the St. Croix river basin would be feasible and advantageous.

The chief engineer of the branch was appointed chairman of the Canadian section of the board, and branch personnel participated extensively in the studies.

The report, which was filed in 1957, covered the potential increased use of storage and power in the basin, fish and game resources, consideration of the restoration of anadramous fish runs, pollution, land management and recreational development.

The committee recently was advised of the federal-provincial investigation with respect to hydro power on the Saint John river. The Saint John river rises, part of it up in Quebec, part of it in Maine, and flows down and

becomes a portion of the boundary between Maine and New Brunswick at this point. Then it cuts through New Brunswick, passes the city of Fredericton, and enters the bay of Fundy at the city of Saint John.

This investigation had been preceded by an international study under the international joint commission. The water resources branch, aided by the Department of Public Works, had the honour of heading up that study in Canada. Investigations of storage and power opportunities were made, and a storage program was presented. Construction of the Beechwood plant, since built by New Brunswick, was recommended as an initial step.

The branch maintains a gauge and flow records and a watching brief with respect to the levels of Lake Memphremagog—which is at this point on the international boundary, between the province of Quebec and the state of Vermont—where it earlier had participated in an international board appointed by the Canadian and United States governments to investigate alleged flood damage to United States citizens by the operation of the Canadian Cottons dam below the lake outlet. The investigation involved back-water computations and gauge relation studies. The study, the report and the knowledge that the operation of the dam was under observation evidently satisfied the claimants.

The branch conducted backwater studies as to the possible effects on the levels of lake Champlain of the construction of the Fryer's island dam and the removal of the natural control at the lake outlet leading to the Richelieu river. The dam was built and a control board was appointed to regulate the levels of Lake Champlain. However, the natural control has not been removed and the gates in the dam have remained open.

The Great Lakes and St. Lawrence river system continues to offer many challenges to the ingenuity of the engineer in the study of its hydrology and the application of hydraulics to the problems of water use. The main stem of this system, with its connecting waters, offers the longest period of interrelated hydrometric records in Canadian waters. Daily water levels are available at several points on both sides of the international boundary, for a period of 100 years. In Canada these records have been obtained by various agencies over the years.

However, for some considerable time the derivation of discharge records in the connecting waters and the St. Lawrence river has been a responsibility of the water resources branch. This has involved making river and canal measurements of flow from bridges and boats, and the rating of powerhouse turbines and sluice openings in power and dam structures.

With regard to the maintenance of level records on the Great Lakes and the St. Lawrence river, the usual pattern of Canadian hydrometric operation is different, in that these are the only interior bodies of water in which federal maintenance of gauges is not conducted by the water resources branch, but by the Canadian hydrographic service of the Department of Mines and Technical Surveys. The branch makes constant use of these records of levels, and in many instances has developed discharge ratings against them.

For some 35 years the branch has provided the Canadian membership on the international board which regulates the level and outflow of Lake Superior. This involves the development and application of rule curves designed to maintain the levels of Lake Superior within a restricted range, the alteration of flow through the gates of the compensating dam and through the power diversion canals, as well as the maintenance of records of discharge through these structures and the navigation locks.

Allowance is made for the release of the additional waters from the Ogoki and Long Lake diversions, and the effects of these diversions on levels and flows as far downstream as Montreal harbour, have been made. Similarly,

the effect of regulation in Lake Superior has been traced downstream by means of extensive flow routing studies through the lower lakes.

The branch has participated in national and international studies, with respect to the effects of diversions at Chicago on the levels of the Great Lakes and the St. Lawrence river; and advises the Department of External Affairs on the technical aspects of this problem.

On the Niagara river, branch personnel have maintained inspection and records of power diversions since the early twenties, and have participated in the activities of control boards and boards for the development of plans for the preservation of the falls. These responsibilities have involved river and hydraulic studies on a broad scale, including the use of river models. Much of the work was undertaken for the international joint commission and culminated in the remedial measures which are functioning so successfully now. The director of the branch is the representative of the Canadian government on the international Niagara committee, and is chairman of the Canadian section of the international Niagara river board of control, which is responsible to the international joint commission.

On Lake Ontario and the St. Lawrence river the branch has had and continues to have many and growing responsibilities. Much time, effort and ingenuity by branch personnel and others has gone into studies of all phases of hydrology and hydraulic design, in deriving a method of regulation which, while narrowing the range of levels on Lake Ontario, maintained or improved conditions for power, navigation and downstream riparian interests.

Involved with studies which were international in character was the co-ordination of various level datums, the determination of the amount of earth tilt affecting lake levels, and the computation of the varying effects of diversions. Determination of the effect of Gut dam on Lake Ontario levels was established through the use of model studies, backwater computations and gauge relation studies.

The director of the branch is chairman of the Canadian section of the international St. Lawrence river board of control, and a small staff has been assigned to the branch to maintain the day-to-day records and computations related to this responsibility. Several senior branch officers maintain close association with the responsibilities of this regulation, and have membership on various international and national committees doing related studies.

The branch has been assigned various responsibilities on the waters comprising the boundary between Ontario and Minnesota, in the Namakan lake, Rainy lake, Rainy river and Lake of the Woods reach. Mention should be made of the Canadian and international Lake of the Woods control boards, on which the chief engineer of the branch is a member. The Canadian board is responsible for the regulation of Lac Seul storage on the English river at all times, and for the regulation of Lake of the Woods storage when that lake is between elevations 1056 feet and 1061 feet. Outside of this range responsibility for the regulation of Lake of the Woods passes to the international board. The regulation of storage on these lakes for maximum use is of great importance to the downstream power plants on the English and Winnipeg rivers, and the conservation, and release available supplies requires a constant study of hydrological conditions. A small staff is assigned to this responsibility.

It should be noted and made clear at this point, particularly when moving into the prairie section of the study, that basic data for hydrologic studies includes not only stream flow, water level and precipitation data but, just as important, topographic data. Without adequate knowledge of drainage boundaries, the areas used in reducing stream flow to unit run off from a

basin, in order to compare and correlate with other streams which may have longer periods of record, may lead to serious errors in water supply estimates, or in over or under designing of structures.

Further, the drainage patterns of prairie streams are poorly defined so that, in many cases, what one might consider as the drainage area of a particular stream is not the actual area which contributes run-off to the stream. For example, the Souris-Red rivers engineering board estimated in August, 1955 that of the area within the boundaries of the Souris river upstream from Westhope, where the Souris crosses the international boundary from North Dakota in Manitoba, only 43 per cent of the area of 17,000 square miles contributes to the run-off from the Souris river.

To define the areas contributing to run-off in a stream it is necessary to have large scale topographic maps of the basin, about a scale of 1:50,000. Maps of this scale are becoming available for the prairies. Until such time as this map information is complete for any particular stream, its limiting draining boundary and the area contributing to run-off can only be estimated.

The problem on the Souris river is one of inadequate supply to meet the demands on both sides of the border. The Souris river rises in Saskatchewan, flows through North Dakota, then into Manitoba, where it joins the Assiniboine river.

The problem was brought to the international joint commission on January 15, 1940, as a result of the extremely low flow conditions in the river during the late 1930's. In October, 1940, the commission reported to governments:

> In view of the incompleteness of available stream flow data it is the judgment of the commission that no permanent method of control and operation designed to regulate the flow and use of the waters of the Souris river and its tributaries should be adopted at this time.

The commission recommended interim control measures which remained in effect, with minor modifications, until May 31, 1959. At this time new interim control measures were instituted.

Although comprehensive stream flow data have now been accumulated these measures are still considered as "interim," because the commission wishes to give further consideration to other factors before making a final report to governments. To give you some idea of the physical size of the Souris river, you might compare it with the Saint John river, which was described briefly for you one week ago. In length and drainage area it is about the same as the Saint John river. However, in flow it discharges less than 1 per cent of the flow of the Saint John river.

On January 12, 1948, the governments asked the International Joint Commission to study the water supply problems on all streams crossing the boundary from the Milk river drainage area on the west, up to and including the drainage area of the Red river on the east, and, where advisable, to make recommendations of apportionment of waters between Canada and the United States.

In the Souris river, this problem is fundamentally one of stream flow routing. The waters of the Souris river have been used consumptively in increasing amounts since the turn of the century. The flow recorded at the several gauging stations is not the natural flow, and has been changing over the years as a result of the increase in uses.

Therefore, the first step in the solution of the problem was the reconstitution of the natural flows to determine what amount of water would have been available over the years. This requires, of course, complete records on the use and the diversion of the Souris river or of its tributaries. Once the figures of natural flow have been obtained, the total demands existing, say in 1940, 1950,

or the projected demands of 1970, could be applied in the computations and the natural stream flow routed through the basin to determine whether these demands could be met. Evaporation from ponds, reservoirs and from the streams themselves is the major consumptive use of water in the Souris basin, and the branch has installed three evaporation stations in the basin in Saskatchewan in an attempt to gain more information on this process.

In order to be able to carry out the new interim measures of May 31, 1959, and in particular, the determination of the natural flow of the river where it crosses from Saskatchewan into North Dakota, additional stream flow stations have been established. The total number of such stations in the Saskatchewan portion of the Souris basin is 32.

The branch will have to prepare bi-monthly, for the board of control, balance sheets showing the amount of run-off, the amount diverted, and the percentage of the natural flow crossing the boundary.

The branch is involved in a number of other problems, as we move west along the boundary, including the St. Mary and Milk river division of available waters for irrigation. But perhaps I should mention particularly, when we move across the Rockies into the Kootenay and Columbia river drainages, that over the years there have been a very considerable number of problems which have reached the International Joint Commission which, in turn, have been turned over to the water resources branch for study of the hydrological and hydraulic effects of various proposals.

I refer particularly to several reclamation areas which were developed in the Kootenay flats, much of which caused an increase in levels at the international boundary and up into Idaho. The effects of these reclamations were computed in the branch and provided to the International Joint Commission.

The West Kootenay Power and Light Company, which operates storage on Kootenay lake, has been before the commission on various occasions with respect to its storage applications. It first came before the commission back about 1929, when it was applying for 6 feet of storage. In 1938, I think, this was granted. During the war it was increased to 8 feet, and later reduced again to 6 feet. The effects of this storage on the various interests around the lake were investigated by the branch for the commission.

The branch was also involved in connection with the effects of the construction of the Grand Coulee dam on the main stem of the Columbia river, the reservoir of which extends across the international boundary and raises the level at the boundary in the neighbourhood of one or one and a half feet. There were other projects in the Columbia basin, including one on Osoyoos lake, on the Okanagan river, where obstructions and a dam at the outlet of the lake were causing high levels and flooding on the Canadian side of the boundary. The improvement of flood conditions on Okanagan river was also investigated by the branch. The branch maintains membership on a board with respect to Osoyoos lake, on a board with respect to the river above Grand Coulee, and a board respecting the Kootenay lake.

You are also aware, of course, of the very extensive investigations which are going on at the present time in connection with the over-all development of the Columbia river. The branch is very much involved in various types of studies, providing technical and professional information for the negotiators on that matter. These studies have included flow routings, investigations of dam sites—a great variety of dam sites—alternative locations, and extensive hydrologic studies; and a very substantial pattern of hydrometric stations has been established in that basin for the purposes of the present negotiations.

Further west, the branch has been involved in the Skagit river problem, where the Ross dam—the city of Seattle's Ross dam on the Skagit river—raises

the level of that river at the international boundary and floods into British Columbia, and in its ultimate design will raise the level at the boundary by over 100 feet.

Coming now to some of the national problems with which the branch is concerned, I think I might first mention the extensive studies which we have been carrying out on the Yukon river, in the Yukon territory, where, while the fall in the river was known, there was no information with respect to particular power sites; whether or not there were power sites there. The branch has had field parties in that area over the past several summer seasons, both on the main stem and on the tributaries of the Yukon river. The report of its findings will, it is hoped, be available to the government later this year.

The study has indicated that there are approximately 4½ million horse-power available on the main stem of the Yukon river in the Yukon territory.

I think you may be interested in the work of the branch in connection with the Red river flood control. Following the flood on the Red river in May, 1950, the federal government, through the former department of resources and development, undertook a comprehensive survey of possible flood control measures for the greater Winnipeg area. A special office was set up in Winnipeg, and the study was completed within three years. This study was the most comprehensive of its kind ever undertaken in Canada.

The report of the Red river basin investigation thoroughly documented the history of flooding in the Red river, which dates back to 1826, and provided a complete statistical analysis on the frequency of floods. The measures of flood alleviation which were studied, included reservoirs, dyking, channel improvements, diversions, and by-pass channels.

The investigation made a most detailed study of the hydrology in order to determine quantitatively the contribution of the various factors which make up a flood on the Red river. As an outcome of this study, a chart was developed which has assisted the Manitoba authorities in forecasting floods on the Red river.

The hydraulic design of the various flood protective measures required the application of back-water curves and flood routing. It should be explained that these procedures cannot be applied blindly, but require a thorough knowledge of the river's characteristics and of the assumptions involved in the computations.

The royal commission on flood-cost benefit, appointed by the government of Manitoba in 1956, recommended, in its report of December, 1958, several of the measures which had been studied in the Red river basin investigation.

During the course of the royal commission's study, the advise of senior personnel of the branch who had worked on the Red river investigation was sought and given.

Manitoba is proceeding with the preparation of final plans for the floodway channel to by-pass Winnipeg, and senior personnel of the water resources branch are involved in the planning and designing for the construction stage.

I think I might refer to the lakes Winnipeg and Manitoba board, on which the branch had federal representation. This board, which is similar in many respects to the Fraser river and Saint John river boards, was established by the Manitoba and federal governments in 1956 to "plan, supervise and carry out a survey of lakes Winnipeg and Manitoba and the resources of waters within Manitoba flowing into and from those lakes, and shall determine and report what further developments and controls of these water resources, in its judgment, would appear to be physically practicable, with particular reference to (a) flood control, and (b) hydroelectric power".

The board consisted of four members; two from the water resources branch, representing Canada, and two representing Manitoba. The studies involved in answering these terms of reference were very technical, and included not only stream flow routing, backwater and related scientific methods, but also a knowledge of system power studies. Over the two years in which this board was in operation, eight meetings were held in Winnipeg, some of which required three days. In addition, senior personnel of the branch attended five meetings of the board's technical committee, which reviewed the technical aspects of the study and the draft reports before they were presented to the board.

Among the problems studied by the board were: (1) the effect of regulation of the lower Saskatchewan river for power on the water levels of Lake Winnipeg and upon the land reclamation projects in the Saskatchewan delta area; (2) the effect of the diversion of the lower Assiniboine river on Lake Manitoba levels and proposals for regulating the lake to provide flood control to shore property; (3) the effect of regulating Lake Winnipeg for flood control and enhancing this for hydroelectric power potential of the Nelson river.

As a result of this study, it is understood that the province intends to undertake the project which will regulate, within a narrow range, the levels of Lake Manitoba and provide flood control to lake shore properties.

It has been drawn to my attention that some opportunity should be provided to the committee to ask questions, if they so desire, and I think I might cut my presentation short at this point in order to permit the questions to be asked. Thank you, Mr. Chairman.

The CHAIRMAN: Mr. Patterson, you have certainly given us an outline of the very extensive duties that your branch is called upon to perform. There is hardly any place in Canada that you have not touched on.

Perhaps there are some specific areas that the members of the committee would like to question on; or there may be questions in general.

Mr. KINDT: Mr. Patterson, you spoke at some length on the St. Croix river and the way it bends down into the United States and back up. There has been some international discussion on that in times past. Were those handled by the joint commission, between the United States and Canada? That is one question.

Mr. PATTERSON: Studies were recently made for the joint commission by an international engineering board, if that is the problem to which you refer, sir.

Mr. McLeod, who is here, was chairman of the St. Croix engineering board which investigated those problems under the most recent reference to the commission. On previous occasions there had not been broad scale investigations, but investigations of the particular problems by and for the St. Croix river board of control, which was set up by the International Joint Commission.

Mr. KINDT: In other words, they made the factual study?

Mr. PATTERSON: Yes.

Mr. KINDT: But any decisions arising out of that factual study were made by the board?

Mr. PATTERSON: Were made by?

Mr. KINDT: By the international board that set the study up?

Mr. PATTERSON: The board made recommendations to the International Joint Commission, and in many respects the commission can only recommend to the governments: there are only particular cases where the commission can order.

Mr. E. A. CÔTÉ (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): I think, Mr. Chairman, it might be said that under the boundary waters treaty of 1909, the two governments may refer questions to the International Joint Commission for study and recommendational report. These are known as references.

The commission only has authority to make studies through its international boards, and to make recommendations to the governments. The governments, thereafter, may accept the recommendations and act on them, if it is within their sphere; or they may propose to governments within the respective countries, or other agencies, certain action that might be taken. It is then left to the appropriate jurisdictions to carry out whatever action they see fit in the circumstances.

Mr. McFARLANE: Mr. Chairman, I would like to ask Mr. Patterson a question. He made some reference to a dam on lake Champlain. Could you tell me what effect that has on the water levels in Canada?

Mr. PATTERSON: Mr. McFarlane, the dam has no effect on water levels in Canada. As I indicated, the natural control of the outlet of the lake has never been dredged out, with the result that the authorities are not allowed to close the dam; the gates are maintained up in the air, and the dam is never closed. So there is a natural flow which occurs at that point at the present time.

Mr. McFARLANE: What was the object of the dam?

Mr. PATTERSON: The object of this dam was to provide flood protection for foreshore interests on lake Champlain. As far as Canada was concerned, the people living around Missisquoi bay and in the region leading down to Fryers island would have benefited, and of course people on the United States side would have benefited. But never since that dam was built has the government seen fit to provide funds for the removal of the natural bed of the river; and until that is removed, if you close the gates under those conditions, you would create a flood condition on the lake rather than improve it.

Mr. McFARLANE: The dam was put in for flood control rather than as a power project?

Mr. PATTERSON: There was no power in connection with it.

Mr. McFARLANE: Thank you.

Mr. PAYNE: I have a reference to some of the dams mentioned earlier.

The CHAIRMAN: A question comes to my mind with regard to lake Champlain. Was that a joint effort? Was the construction of that dam financed by Canada and the United States?

Mr. PATTERSON: No, as I understand it, it was financed completely by Canada.

The CHAIRMAN: In what year was that dam erected?

Mr. PATTERSON: In the late thirties. The hearings were held about 1936, and the dam was constructed shortly thereafter.

The CHAIRMAN: Have you any recollection as to the cost of that project?

Mr. PATTERSON: No.

Mr. KINDT: It was solely for the purpose of regulating the behaviour of the river?

Mr. PATTERSON: That is right. And I believe it was considered to have some beneficial effect on navigation around the canal that exists at that point.

Mr. PAYNE: I have a few questions I would like to ask supplementary to the evidence given today on the Fraser river board, and since we are dealing more with international water resources, I wonder if I would be in order.

The CHAIRMAN: I think you are quite in order to ask questions about it.

Mr. PAYNE: The basic point I was wondering about was this: possibly I did not hear the witness correctly today, but it has to do with the studies relating to the forestry operations, as covered at page 147; and I think Mr. Patterson suggested that further information would be brought to the committee. I may not have heard it rightly, but I do not believe there were any answers given in your further answers today.

Mr. PATTERSON: Mr. Chairman, I addressed a letter to you some time ago, and I had understood that it went into the record of this committee.

The CHAIRMAN: I believe so.

Mr. PATTERSON: That letter was supposed to answer that particular question, Mr. Payne.

Mr. PAYNE: My apologies, then. I was earlier going to suggest to the chairman that I thought that if you would agree, I would defer any questioning until I had had an opportunity to peruse the evidence today. I wonder if Mr. Patterson will be with us again, or whether I shall have an opportunity to go into this some time later?

The CHAIRMAN: It is pretty hard to tell at the moment. We have a pretty full agenda, which will take us up to about the middle of June, which, I think, would be getting close to the time we should report back to the house.

Mr. PAYNE: We have had evidence today which I think should be looked at before a series of questions are asked on the Fraser river board and its operations. They are certainly of importance not only to British Columbia people but also to all Canada, and I think this matter should be gone into in a thorough way. We arrived at a point when certain matters were left in some suspense, and there is not any information before this committee from fishery sources.

The Fraser river picture is one shrouded in clouds of mysticism, and I think there is a responsibility in this committee to try to evolve factual information from which the public could establish its own basis of thinking and of approach.

Mr. CÔTÉ: I would like to say a word to that, if I may. For several months now plans have been made for Mr. Patterson to be the Canadian delegate to the international water power conference which is to be held in Madrid. Mr. Patterson will have to leave at the end of this week unless the committee otherwise orders.

However Mr. Paget, who is joint chairman of the chairman of the Fraser river board, will be, we expect, available at the beginning of next month for questioning by the committee; and in addition there will be the senior officers of the water resources branch who could reply to those questions.

Mr. PAYNE: The witness has been most helpful and cooperative and I would be the last one in the world to see this committee interfere with Mr. Patterson's very important trip. I would only suggest to the steering committee that the committee have an opportunity to meet with Mr. Paget. I do not think it would take a great deal of time, but there are certain matters which in the public interest the committee should draw out, and I think it would be helpful.

The CHAIRMAN: We shall certainly do our best to give the committee every opportunity to hear further evidence on the problem of the Fraser river.

We shall have Mr. Paget coming before the committee on June 7th. Mr. Paget is comptroller of water rights, Department of Lands and Forests, of the province of British Columbia, and, as Mr. Côté has said, he is joint chairman of the Fraser river board.

I suggest that possibly between Mr. Paget and some other officials of the department here we would have pretty full information.

Mr. PAYNE: It would certainly be my wish, and I think I have the support of the committee, that we hear from these fisheries people, possibly from Dr. Whitmore.

The CHAIRMAN: Would you care to discuss that matter with me later? I can take it up with the steering committee and we can try to arrange to have witnesses from the fisheries department.

Mr. PAYNE: That is fine. I am sorry I have taken up so much time.

The CHAIRMAN: The question you referred to in regard to the forest cover of the Fraser river basin was answered in a letter to me which is printed as an appendix to our proceedings of May 16.

Mr. PAYNE: My apologies.

The CHAIRMAN: We have some information here which I would like to give to the committee. It has to do with some questions which were asked some time ago in regard to prosecutions under the various acts that come under federal jurisdiction. Is it the wish of the committee that these letters and this information be printed as an appendix to today's proceedings?

Mr. KINDT: I so move.

Mr. LEDUC: I second the motion.

The CHAIRMAN: The motion is agreed to; so we will have this information printed, rather than having it read out at this time.

I will give you a brief outline of the witnesses that we expect to have here for a number of meetings ahead. We expect to have Professor Kuiper of the department of engineering, university of Manitoba on May 30, to discuss water problems in Manitoba.

On May 31, we hope to have Mr. MacNeill, executive director, south Saskatchewan river development commission. He has indicated his willingness to appear before the committee to discuss river basin development in Saskatchewan; and also Mr. Cass-Beggs, general manager of the Saskatchewan power corporation; he has indicated his willingness to come as well.

On June 6, we expect to have General McNaughton, chairman of the Canadian section of the international joint commission.

On June 7, as I said, we expect to have Mr. Paget, comptroller of water rights, Department of Lands and Forests, of British Columbia.

And we have tentatively planned on June 13 to have Mr. Matte, associate director of P.F.R.A., Ottawa, to discuss the water problems that come under prairie farm rehabilitation assistance, and also Mr. MacKenzie, of P.F.R.A., Regina.

Mr. PAYNE: What date was that?

The CHAIRMAN: June 13. If there is nothing further the meeting is now adjourned.

**APPENDIX "A"**

NATIONAL HARBOURS BOARD
CONSEIL DES PORTS NATIONAUX
CANADA

OTTAWA, May 13, 1960.

Mr. R. G. Robertson,
Deputy Minister,
Department of Northern Affairs and National Resources,
Ottawa, Ontario.

Dear Mr. Robertson,

Discharge of Oil or Other Wastes into National Harbours
Convictions

In response to your enquiry of the 10th instant, I have to advise you that although there have been several cases where parties were warned or reprimanded by the local Port Managers for discharge of oil or waste, no actual prosecution has been instituted by us at any Board harbour within the last ten years.

Yours very truly,
Maurice Archer,
*Chairman.*

DEPUTY MINISTER OF TRANSPORT
OTTAWA, CANADA

MAY 17, 1960.

Mr. R. G. Robertson,
Deputy Minister,
Northern Affairs and National Resources,
Ottawa, Canada.

Dear Mr. Robertson:

With reference to your letter dated May 10, 1960 on the subject of water pollution, the jurisdiction of this Department extends only to the oil pollution of the waters of Canada directly attributable to ships.

The Oil Pollution Prevention Regulations, P.C. 1960-166, were made under authority of Section 495(a) of the Canada Shipping Act, and I enclose a copy for your interest. These Regulations constitute a revision of the original Oil Pollution Prevention Regulations, P.C. 1957-392 of 21st March 1957.

In practice, considerable difficulty has been experienced in attaching actual blame in cases of alleged oil pollution by ships. However, two cases have resulted in conviction. One of these involved a domestic schooner operating on the river St. Lawrence and the other a large foreign flag tanker at Harmac, B.C.

Both of these convictions were obtained in 1959 and the first resulted in a fine of $50 being imposed on the master of the schooner and fines of $50 each on two crew members. The second incident resulted in a fine of $250 being imposed upon the chief officer of the foreign tanker.

The specific details are as follows:

(*a*) Schooner "Nord de l'Isle" offence occurred at Trois Pistoles, P.Q. on August 23, 1958. Master and two crew members convicted at Riviere du Loup, P.Q. on 28 February 1959. Master, Joachim Harvey, fined $50.
Crew members Joseph Harvey and Remi Harvey each fined $50.

(*b*) Liberian oil-tank steamship "Kia Ora" offence occurred at Harmac, B.C. on 26 February 1959.
Chief Officer, George Schnurrer convicted at Nanaimo, B.C. on September 30, 1959 and fined $250.

Yours very truly,
J. R. Baldwin,
*Deputy Minister.*

Report on Prosecutions for Oil Pollution under Section 40 of the Migratory Bird Regulations

The Dominion-Provincial Wildlife Conference recommended in 1948 that the following provision be placed in the Migratory Bird Regulations:

> No person shall knowingly place, cause to be placed or in any manner permit the flow or entrance of oil, oil wastes or substances harmful to migratory waterfowl into or upon waters frequented by migratory waterfowl or waters flowing into such waters or the ice covering either of such waters.

Although we have had that provision for 12 years, no convictions have been made under it. The principal reason is that most waters frequented by migratory waterfowl and subject to pollution are in the developed areas of the country and are covered by prior legislation, such as the Fisheries Act and federal laws dealing with harbours, navigable waters and shipping. Migratory waterfowl may be harmed by pollution not covered by those laws, but such instances are likely to be of a local and temporary nature, difficult to detect, and often escaping observation and report.

During the past 12 years about a dozen cases of pollution have been investigated wherein the possibility of laying a charge under the Migratory Birds Convention Act was considered. In some cases the pollution could not be traced to an individual or corporation. In other cases the pollution proved to be accidental and since our regulation contains the word knowingly, prosecution was not possible. Our investigation in those cases has usually resulted in action to abate the pollution or to prevent a recurrence.

Other sources of pollution, sawdust, city sewage or industrial waste may cause damage to fish but it is difficult to demonstrate that waterfowl are being directly harmed.

The most troublesome areas are in the heavily industrialized portions of Ontario and Quebec. In other inland waters pollution is not a continuing problem to waterfowl.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 14

---

MONDAY, MAY 30, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESS:

Mr. E. Kuiper, Associate Professor, Department of Civil Engineering, University of Manitoba.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23213-2—1

STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.,

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, May 30, 1960.
(15)

The Standing Committee on Mines, Forests and Waters met at 11.45 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Granger, Gundlock, Hicks, Kindt, McFarlane, McQuillan, Mitchell, Payne, Simpson and Slogan.—(10)

*In attendance:* Mr. E. Kuiper, Associate Professor, Department of Civil Engineering, University of Manitoba. *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Mr. Kuiper, and he made an extensive statement on the various aspects of water problems in Manitoba including water power development and flood control, and was questioned thereon.

During his presentation, Mr. Kuiper emphasized various points by referring to a wall map and the use of slides.

At 1.10 p.m., the Committee adjourned until 9.30 a.m., Tuesday, May 31, 1960.

M. Slack,
*Clerk of the Committee.*

# EVIDENCE

MONDAY, May 30, 1960.

The CHAIRMAN: Gentlemen, after a lot of hard work we finally have a quorum. So let us proceed.

We have with us today Professor Kuiper, who is associate professor of civil engineering at the university of Manitoba. He will speak to us on water problems in Manitoba. So I now invite Professor Kuiper to give his presentation.

Professor E. KUIPER (*Associate Professor of Civil Engineering, University of Manitoba*): Mr. Chairman and gentlemen: I have been asked to present a talk on water problems of Manitoba. There are various aspects of water problems such as water power development, flood control, possibly irrigation, pollution, water supply, and drought.

I would like to propose to you that we discuss water power development first in Manitoba, and flood control afterwards, when we may be able to touch on irrigation and water supply. When we have looked at these problems—and we shall be looking at them from an integrated viewpoint—you can see how development takes place on an integrated basis.

To start with water power development, we will have to go back some 40 to 50 years in history and to the first water power development that took place in Manitoba. That was on the south branch of the Winnipeg river, bypassing the main stream. This development took place in 1906. At that time this was a quite significant development in Manitoba, and from the point of view of water development, on the whole North American continent.

The transmission line was longer than at any other place on the North American continent, and the development itself was also of considerable size. But right now when we look back at that small Pinawa plant, we find that it has now become obsolete. About five years later, following increased demand for power in the Winnipeg area, more and more plants were developed on the Winnipeg river.

The Winnipeg river is ideally suited for water power development because its flow is constant, and there are natural reservoirs available which tend to smooth out the water supply. Also, in the pre-cambrian shield foundations for power sites were excellent, and due to the existence of natural reservoirs, flow conditions were also very favourable.

So in between the early 1900's and the present time we have seen the development of the Winnipeg river at several sites such as Slave falls, Pointe du Bois, Seven Sisters, and Great falls, and we have five falls here. That completed the development of the Winnipeg river in Manitoba.

While development went on in Manitoba, there was also development taking place in Ontario on the Winnipeg river. First of all there was a plant built on the Lake of the Woods, and afterwards a few more plants. Presently the situation is such that we can for practical purposes say that the Winnipeg river between its two large hydro electric reservoirs, such as the Lake of the Woods and lake Winnipeg is pretty well developed from the power viewpoint. Sites are developed, and maybe a little more installed capacity could be developed, but no more sites.

Now, power use in the city of Winnipeg and surrounding areas has been rising over the last 40 years at an average rate of about seven per cent per

year. As far as we can make out, that kind of rate of power growth will proceed into the future, barring of course any unexpected events.

That means that ten years from now we will have about twice the generating capacity in Manitoba that is available now. Right now it is mostly on the Winnipeg river. But where are we going to get additional generating facilities?

There are several alternatives. One is to pursue hydro development. Additional hydro development may be found first at Grand rapids, which is at the lower end of the Saskatchewan river, where Cedar lake empties into lake Winnipeg, and where there is a drop of about 120 feet.

Secondly is the Nelson river. Lake Winnipeg has an elevation of about 712 feet, and Hudson's bay, for practical purposes is at sea level. So we have a natural drop here of a little over 700 feet. The Nelson river itself is quite suitable for power development. It flows for its larger part through the precambrian shield, where there are several sites, and where foundation conditions are excellent. Due to these large lakes, the flow is quite even.

There is an average flow of 70,000 cfs, as compared to an average flow on the Red river of only a few thousand cfs. So that with this large flow, it is smoothed out over the year. It has good foundation conditions for hydro sites and the development of hydro on the Nelson is quite favourable. In fact total plans have been made for development of about a dozen sites which are from the engineering viewpoint quite feasible to construct.

From this map you will appreciate that one of the difficulties of the development of hydro on the Nelson is its distance from centres of population. From here to here is a distance of about 400 miles, and if we go up to the mouth of the Nelson, it is about 600 miles. Fortunately the technique of long distance transmission is making rapid progress and we believe, from the engineering point of view, power from the Nelson river can be transmitted to the Winnipeg centre at an economy of five to six mills per kilowatt hour.

So here is the first alternative for future power development.

The second alternative would of course be thermal generation at Winnipeg, with more plants at Selkirk and another at Brandon, and certainly further development of steam plants and gas turbines in this vicinity.

Finally there is the prospect of nuclear development, which might be economical 20 to 30 years from now, but we do not know exactly when. There are several reasons: first of all, the main reason is that we do not know what the development and technology of nuclear power will be over the next 10 to 12 years.

Right now nuclear power would cost us somewhere between 10 to 15 mills per kilowatt hour, and that is too expensive to be incorporated in the Manitoba generating system. But in the future it could be that the price might come down to four, five, or six mills per kilowatt hour.

Now, this is a subject in itself—how is power going to be developed in Manitoba in the future?

Since we are dealing mostly with water problems in Manitoba today, I would propose that we leave this subject aside, and just tell you that the conclusion of a long-term planning study has been that before a considerable amount of thermal power and nuclear power is developed in southern Manitoba we should develop, first, the hydro sources on the Nelson river. This potential is so large—in order of magnitude of some 4,000 megawatts, as compared to the present 500 megawatts here, which is, roughly speaking, eight times as much as on the Winnipeg river—this potential is so large that it may last another ten or twenty years, before we have to go somewhere else for generative facilities. So much for hydro power, for the time being.

Let us look at another facet of water resource development, mainly that of flood control. As a result of the events in 1950, when the Red river and the Assiniboine river combined to flood a large part of the city of Winnipeg, it caused damage in the order of magnitude of $50 million to $100 million. Let me take a moment to sketch the situation, briefly. About 10,000 years ago this part of Canada was covered by glaciers, and the run-off from these glaciers, which was in this direction, caused the formation of a huge glacial lake which drained to the south. The western boundary was the Manitoba escarpment, here, and the eastern boundary the high land here. The silt that was deposited in the glacial lake by the rivers formed the very fertile plan we now know as the Red river valley. When western Canada was settled that is the part where the settlers went first, on the alluvial plain.

Besides being fertile, being the former bottom of the huge glacial lake, the topography was very flat, and when the Red river and the Assiniboine river do get into a high state of run-off that whole huge area becomes inundated by flood waters, which causes a tremendous amount of damage. If this had been realized 100 years ago Winnipeg undoubtedly would have been built at some other location, like Selkirk, or further west along the Assiniboine river. The people who did settle there, although they had the experience of the 1826 flood to fall back on, did not draw the proper conclusions, and did settle here, at the conjunction of the Assiniboine and Red rivers. Thus we are plagued with the situation of being located in the most unfortunate place.

There are several means of coping with the flood situation in Winnipeg. In general, it can be cured by the construction of reservoirs in the headwaters, or by building dikes, or by digging out a deeper channel, so that the water can run off faster and more efficiently, or by a complete diversion of the flow around that area.

After the flood of 1950 these engineering possibilities were investigated, and the Red river basin investigation was initiated. For about three years a group of ten to twenty engineers studied the various possibilities of coping with that situation. Let me not go into details of the investigation and all the alternatives, which were dozens, but let me just say that the end result of the study was that the most efficient way of coping with the flood situation in greater Winnipeg was; to divert the Assiniboine river into Lake Manitoba, and bring the water permanently out of the Red river system; two, to divert the Red river around the city of Winnipeg, in a huge, deep canal; and, three, to construct a headwater reservoir on the Assiniboine river.

The significance of these three projects, in order of magnitude, is, primarily, the flooding east of Winnipeg; second, this diversion at Portage la Prairie; and, third, this reservoir here. This reservoir also has some benefits from the viewpoint of water conservation and will help balance the low flows of the Assiniboine river during periods of low runoff.

There are more flood problems in Manitoba than just this one around Winnipeg. Another problem exists in the Saskatchewan delta, although it is a problem entirely different from this problem. In Winnipeg we have a large settlement in a city of some half-a-million people. They have elected to live there, and now they want to protect themselves against flooding. In the Saskatchewan delta we have an entirely different problem, and here is the town of The Pas, and the Saskatchewan delta extends over an area somewhat like this, a huge delta to the extent of some 2 million acres; and right now, except for the town of The Pas and some small Indian settlements west and east of The Pas, nobody lives in the Saskatchewan delta. It is virgin land, has extensive marshes and river arms meandering all over the place, and vegetation on the marshes is reeds and willows and some other types of taller vegetation; and for the rest it is virgin country. But that country is extremely fertile because of the disposition of silts and clays over thousands of years in

the past. An exploratory reclamation scheme has taken place during the last ten years, and as a result of that it was found that the soil is extremely suitable for agriculture. When you talk to people who farm in that area they will tell you they have never found better land in all western Canada than they have in the Saskatchewan delta. So a flood control scheme in the lower Saskatchewan delta is one of reclaiming land rather than protecting existing settlement. They have conducted reclamation investigations during the last ten years, and the engineers have laid out a reclamation scheme for the area here, and a reclamation scheme for the adjacent Saskram area; and, finally, a reclamation scheme for the Moose lake area east of The Pas. These schemes involve the construction of dikes to prevent the high river flows from coming into the area, and the drainage of the interior lands to remove the higher runoff during periods of heavy rainfall.

This is quite an attractive scheme from the viewpoint of gaining land for agricultural purposes, although such a scheme under present agricultural circumstances may not be attractive from the viewpoint of the production of agricultural products.

From the viewpoint of engineering, however, this is a most attractive scheme. These dikes and drainage canals would be built at a cost of approximately $25 per acre of land. If you compare that to the cost of irrigation schemes on the Saskatchewan river or in the United States on the Missouri river basin and other places, it is quite low in comparison. An irrigation scheme may involve an expenditure of $100, $200, $300 or $500 an acre to irrigate land. Therefore, you will appreciate that this proposal of $25 an acre to make land suitable for agriculture is quite attractive. So, I think when the time will come when agricultural products will be in more demand than now, this will be one of the schemes which will go ahead very rapidly.

We have covered the flood flow control situation here, in this area. Let me speak for a moment about the flood situation around lake Winnipeg and lake Manitoba. The inflow into lake Manitoba under natural circumstances is primarily from lake Winnipegosis, up here, which has tributaries extending to the Manitoba escarpment and inflow from a rather small insignificant stream here, the Whitemud river. The inflow into lake Manitoba is relatively small. Its inflow being small, the outflow capacity also is small, and as a result the fluctuation of lake Manitoba over 40 years has been in the order of five or six feet. The fluctuation occurs very slowly. During the dry thirties and the early forties it was very low, and then in a period of five or six years it gradually rose. The farmers farming adjacent to the lake have a tendency to move closer to the lake in the low periods to find suitable grazing. Then in the high lake stage, such as in 1953, 1954 and 1955, which was an outstanding example when the lake was five or six feet higher, the farm buildings were inundated, the lands were not suitable for hay or pasture and the cattle had to be moved. When you hear what the delegations of these farmers say, it is evident that this really is a serious hardship for them. It is not matter of a month's period, but rather it is several years in succession because these high lake periods might last for several years, as did the previous low. After 1953, 1954 and 1955, there was delegation after delegation of the farmers living around lake Manitoba which applied to the government for control of lake Manitoba.

After having reviewed the flood control situation here and here, and the power situation here, you may appreciate when you start doing something about lake levels that something will happen to the water resources development at other places. So the government, instead of studying the problem of lake Manitoba in itself initiated an engineering board called the lakes Winnipeg and Manitoba board to study the water resources development of all streams flowing into and moving out of lakes Winnipeg, Manitoba and Winnipegosis. In other words, this board was instituted to make a full-scale study as to how this all ties in together.

Let us deal for a moment with the result of the findings of that study. It was found that control of lake Winnipeg has a very significant effect on the farm interests around the lake, although they are not very significant, and also on the power situation on the Nelson river. If you want to utilize lake Winnipeg to its fullest potential for power purposes exclusively you would like to regulate it on a range of 712 to 715 or 716, or something like that, four feet of water over the whole lake. The surface of the lake alone is 6 million acres, and four feet times six million acres is 24 million acre feet, which is in the order of magnitude of the largest reservoir projects you would find anywhere in the world—in Russia, Egypt or the United States. This is a tremendous volume of water which could be stored and utilized for power development.

On the other hand the people who live around lake Winnipeg would by no means be pleased with such an elevation. In some years with such an elevation they had flooded land and they did not like that—crops were damaged and so on. It was up to the lakes Winnipeg and Manitoba board to investigate these aspects and somehow evaluate in dollars and cents in order to get a figure of the significant aspects of the problem. It was found that the power interests of regulating the lake were in the order of magnitude of a gain of millions of dollars per year. So if you regulate the lake as compared to no regulation at all, the gain in power development would be several millions of dollars a year, assuming a time in the future when all these plans are developed, which may be 20 years from now. On the other hand the interests of the farmers around the lake were in the order of magnitude of say $100,000 a year, which is much smaller.

There is, of course, also the interest of the beach resorts, which is very difficult to evaluate in dollars and cents. But as a whole, we may draw the conclusion that the people of Manitoba would probably attain a higher standard of living, a higher production of their potential resources, if this lake was primarily developed for water power than if it were primarily developed for flood control. The recommendation of the report was made somewhere along those lines.

There is a copy of this report here, if you wish to consult that. There are copies available in Ottawa; and if you would apply to the provincial government in Manitoba, they would be very happy to provide you with copies.

The control of lake Manitoba was found to be not very significant for the power development in this area, mostly because its size is smaller than lake Winnipeg and its inflow and outflow are also very much smaller than lake Winnipeg. If you have 7,000 c.f.s. to play with, you can do quite a bit; if you have only 2,000 c.f.s. to play with, you cannot do very much.

Fortunately, the farming interests were just the other way 'round. They were small, around most of that lake, or insignificant. They were significant around lake Manitoba, so lake Manitoba was hardly useful for power interest, but very important for flood control because of the local people 'round the lake. So the lakes Winnipeg and Manitoba board's conclusion was that it might be possible in the future to develop lake Manitoba, to maintain a close rein on lake Manitoba for flood control purposes.

In fact, a level of 813 was recommended—and you consider the development for power on lake Winnipeg between something like 712 to 715. This 16 may be on the high side, but there is no use defining that too closely now because it only becomes a real problem 10 or 12 years from now, and by that time people may have different views on these problems.

Since the time is rather short, I would suggest that we leave it at having touched upon those major problems, and if you wish to ask about these problems that we have discussed, or other problems, let us do that in a discussion afterwards. If you like, I could show you, in about 15 minutes' time,

some slides of the Saskatchewan river, and the Assiniboine river, the Winnipeg river and the Nelson river, so that you know what the streams are like that we are talking about. What is your wish, Mr. Chairman?

The CHAIRMAN: What is the wish of the committee: would you like to ask questions now, or would you rather see these slides so that you get a complete picture of the whole area?

Mr. SLOGAN: How long will it take to see the slides?

Mr. KUIPER: I think we could run through them in 10 to 15 minutes.

Mr. SLOGAN: Perhaps we should do that and get finished, and then start on the questions.

The CHAIRMAN: Very well. Then we will see the slides now, Professor Kuiper.

Mr. KUIPER: On this first slide you see the Nelson river drainage basin, more or less the same sketch as was on the black board. I would like to show you this item first. You see the Rocky mountains, and then we will go down the south Saskatchewan river to see a few slides of the delta area. Then we will have a look at a few slides of the Assiniboine river, a few slides of Lake Winnipeg itself, and a few slides of what the Nelson river looks like at a few spots on the river.

Next slide. Here you see the Saskatchewan delta. The power is situated here. The green area is the reclamation area; the potential reclamation area being composed of silts and clays deposited by the Saskatchewan river. The pasture area has been developed during the past five years. The Sipanok area here is a potential area for reclamation in the future, and so is the Moose lake area here.

Next slide. This is the headwater of the south Saskatchewan river; some creek of which I do not know the name, flowing into one of the glacial lakes. Immediately outside the foothills of the Rocky mountains, rather than the alluvial planes that you usually find at the foothills, the Saskatchewan river cuts itself deeply into the rolling hills east of the mountains, and this is where erosion takes place.

You can see very active erosion; it is actively sliding down. In contrast to the last picture, where you may have noticed the clear water, you can see, for 15 miles distance, muddy water. It appears to pick up silt, and it keeps on picking up silt for another 10 miles; and finally, when it reaches the Saskatchewan delta, all that silt has been picked up here is deposited in the Saskatchewan delta.

This, again, is another 100 miles downstream of the South Saskatchewan river, and is an entirely different landscape. This resembles the badlands topographic erosion, sandstone and shale. The erosion in this part of the country is by no means as bad as upstream; but neither does any deposition take place.

This is a young river valley, with many plains and uphills.

This is a picture of the Saskatchewan valley, as you visualize it when you speak of the Saskatchewan valley. You will note the rolling plains and smoothly sloping hills down to the valley. This is a distance of, perhaps a few hundred feet.

On one of these slides, which is similar to this one, you will note the space allotted for the South Saskatchewan dam site. In about five or ten years, it will prove to be one of the largest irrigation projects in Canada.

This is one of the P.F.R.A. survey parties, taking samples of the Saskatchewan river. This will take place over several years. You will note two canoes, with a platform in between, and some instruments to take samples of the water.

Here you see an aerial view of the upper end of the Saskatchewan delta. The channels of the Saskatchewan river are continuously shifting over the whole delta area. We are standing at the apex, here, at the western end. The Pas is here, and in the far distance, which you cannot see on this slide, is Lake Winnipeg.

From here lies the whole delta area. This is one of the channels, which is insignificant now—the north Angling river. Relatively speaking, it is an old channel. It is old, in terms of delta development. Due to the continuation of overflow of water and sediment, the river has deposited natural levees, and is being built up high with pronounced vegetation. This has gone on for hundreds of years and, finally, those banks became so high above the adjacent landscape, that somewhere the river breaks through its natural levee, and chooses a different course.

You can see the water being deprived from this channel, following this marsh, feeding its way through here, and building up new banks. You will note on these new fresh banks, the forms of reeds, willows and poplar trees. In a couple of hundred years from now, this river channel will look like this one. This one will be abandoned, will be grown over with reeds and so on, and will be scarcely recognizable.

This was taken at flood stage. You can see the water is quite muddy. It overflows all the land. We had occasion to travel about 100 miles from Sipanok to government house, and we could not find one spot to pitch our tent. The whole area was covered with water. When you go in here, after the flood is over, you find a few inches—possibly six inches—of silt, depending, on the severity of the flood.

Here is another look at the Saskatchewan dam. The Pas is over here, and we are proceeding downstream. This is an overflow of the Saskatchewan river. This flows all in one channel, as opposed to other occasions where we had flows in numerous channels. If you take a survey across here you may find that the natural bank of the Saskatchewan river, at this place, is 10 to 15 feet higher than the adjacent marshes here. So, if it was left to its nature, it probably would breach this somewhere, in the future, and choose a different course. This area is part of the planned reclamation area and, perhaps, fifty years from now, we may see a dike here.

This is a view of the Saskatchewan river, in its middle reaches. You will see The Pas is immediately to the right; and up here, we have the delta area in its natural state—while the river is in flood stage; so, a lot of water overflows, and comes out in this area here. The area here has not been reclaimed. A dike has been constructed here. This area has been farmed, and good crops are raised.

This is an aerial view of The Pas, with the Saskatchewan river proceeding down in this direction here. There is a little Indian settlement called Pine island. It is an extremely primitive way of living. You may stop here for a few moments, and although there are lots of children standing in the doorways watching you, as soon as you step out of your car, they all flee into their houses and watch you behind the windows.

Here is a view of the Saskatchewan rapids, and the Grand rapids where the Saskatchewan empties into lake Manitoba. We have a drop here of approximately 70 feet, but this will be blocked off by the Grand rapids power development. The total head which can be made available is approximately 125 feet.

In the next picture you will see the mouth of the Saskatchewan river. Up here is Cedar lake. This river will be blocked by the dam, and there is a spillway up here at the end of this blind canal, here, where a power house will be situated. Over here power will be developed at a head of 120 feet, and with an average flow of some 20,000 cfs.

Here are a few slides of the Assiniboine river. This one should follow after the following one. Here is a view of the Assiniboine valley during flood time.

Here you have the high land of central Manitoba and Saskatchewan. In the early days the Assiniboine river was able to take care of the flow of all the run-off of the great rivers up north. But right now we have a rather significant Assiniboine river. Normally it ends like this, but occasionally in flood time there is a run-off of twice the normal amount when the whole valley becomes inundated.

Fortunately there are few buildings here, although crops may be lost for a few years in a row.

This slide gives a view of the Assiniboine river valley during normal times. You can see the river here. Its total length may be two or three times as much as the crow flies.

Here is the Winnipeg river. This is White Dog Falls, following on down here, parallel. Right now this fall does not exist any more. The White Dog Falls plant was built a few years ago, but this is a typical picture of the streams in the pre-cambrian shield.

Here is a typical site on the Winnipeg, showing rock formation. You can see how clear the water is, the ledge being visible underneath the flow.

Here are a few pictures of lake Winnipeg, showing Hecla island. This is at the extreme northeastern end of Hecla island. This is looking south, while the larger part of lake Winnipeg is down here.

This is a view of Great Bear island looking west. This is a view of lake Winnipegosis.

We have now arrived at the Nelson river. This is one of the last remaining important virgin power sites in Canada. Here is White Mud falls. The flow of the entire river is concentrated through this gorge. There is a natural drop of some 35 feet. If a power dam were built here, the head raised to the next power site at Fork rapids would probably be 45 to 50 feet.

The flow that you can see here passes through these falls, at approximately 70,000 cfs. This is a view of the same falls taken from here.

The drop down here at White Mud falls is 15 feet. This part of the country is undeveloped; there are no highways or railroads. There is the Hudson's Bay Railroad eventually over here, but in order to have access to this part, you would pretty well have to go in there by canoe, and travel by water. Hill rapids, another potential power site. In a case like this, an outlet would be built somewhere here, downstream of the falls. There would be a power plant here, a spillway over here, with a couple of dykes each side, to tie in the high land with the structures themselves.

We have now reached the lower part of the Nelson river, and here you see the site of the potential power development at the so-called Limestone rapids, where it might be possible to develop some one million kilowatts, nearly twice the total presently developed power on the Winnipeg river. All this development would take place on one site down here, with a total head of well over 100 feet, and having an average flow of about 70,000 cfs available. You will appreciate that is a significant development; or, at least, it could be. The foundation conditions are not too bad. They consist of limestone; but it will be quite an engineering problem to tie in the structure with the steep clay banks. They do not look very steep and high from the air, but these banks are two or three hundred feet high, and consist of clay and are in permafrost. A few feet under the surface there is permafrost. The engineering problem is, if you did build a dam you would create a higher reservoir, and what will that water do to the frost condition in the ground? You are faced with sliding and seepage, and all sorts of problems. That is a job for the engineers.

The last picture is the mouth of the Nelson river. You can see the distinction in the clear water and that of the Hudson Bay.

Mr. KINDT: How deep would the banks at Nelson be?

Mr. KUIPER: Not as high as in that second-last picture.

The CHAIRMAN: I am sure we have learned more about Manitoba in a few minutes than I have learned all my life.

Mr. SLOGAN: Mr. Chairman, I would like to add my thanks to those of the chairman of the committee for Mr. Kuiper's coming here and explaining this to us.

From time to time, before this committee, in the study of water resources, the question of federal-provincial responsibility has come up. I notice in the royal commission on flood cost benefits, 1958, the dissenting commissioner, Mr. McDowell, made a statement that:

> The dominion government has authority over, and is responsible for, the water that flows in such (navigable) streams, while the provincial government has authority over and is responsible for the bed of such streams.

I just wondered, Professor Kuiper, in your opinion, do you agree with that statement?

The CHAIRMAN: Professor Kuiper is here not as a representative of any government.

Mr. SLOGAN: I ask him in his personal capacity; I just wondered. This question of federal-provincial responsibility is one we could not pin down. I wondered what your personal idea was regarding where dominion and where provincial responsibility ends in navigable streams.

Mr. KUIPER: My main field of interest is water resource development, from a technical viewpoint. Frankly, I have not thought about this question of yours, where the responsibility of one begins and where the responsibility of the other one ends. I hate to give an answer right now and regret it, maybe, an hour later. I have not thought about that.

Mr. SLOGAN: I will switch to another subject. You did mention the eastern tributaries diversion from the Roseau river via Cooks creek. I notice it is mentioned in the report.

Mr. KUIPER: Yes.

Mr. SLOGAN: Is it the intention of the government of Manitoba to go ahead with this project?

Mr. KUIPER: As far as I know the eastern tributaries diversion was investigated by the Red River basin investigation, and was reported upon by the commission, but it was not recommended by the royal commission because it was too costly and as having a benefit that was less favourable than the alternatives.

Mr. SLOGAN: Another thing I would like to ask you about is this flood benefit cost study. Since this report came out—I believe in December of 1958—do you think the cost of constructing the floodway around the city of Winnipeg has increased to any extent?

Mr. KUIPER: No, not since that report came out. In fact, I think, if anything, there may be a tendency towards a slight reduction in cost since there is more competition among the contractors. But this is all pure speculation. It is so difficult for an engineering organization to estimate the cost of a large project. Half a year ago the bureau of reclamation let contracts for a large hydro electric development. With their wide experience they estimated it would cost $110 million, and it was let for $80 million. When there is such a tremendous change in the estimate of engineers, who are quite capable

engineers, and the final price at which it is let to the contractor, I hope that will make you appreciate that to estimate the cost of the Winnipeg floodway, within a few per cent accuracy, is simply impossible.

Mr. SLOGAN: Regarding the Winnipeg floodway, was any consideration given to the path of the Red River going where the floodway will enter the St. Andrew's lock, or what effect the added amount of water that is going to be converging at that point on the river will have on the northern stretches of the river to lake Winnipeg.

Mr. KUIPER: Yes. Consideration was given to this and the effect was found to be very small. Whether you discharge the water through the Red river channel only or through the Red river channel plus the other makes no difference to the people downstream.

Mr. SLOGAN: Would not the flow be increased if they do some dredging in the Red river channel, and then add the Manitoba floodway where there are many drainage projects which will be diverted into it? Would not the total volume of water be greater than if the channel was dredged alone.

Mr. KUIPER: Any flood control project which will eliminate flooding of the Red river valley and keep the water in the channel is bound to increase the flow, but whether you do it by diking, diversion or dredging is immaterial.

Mr. SLOGAN: They did not feel the increase in the amount of water north of the floodway would have any effect on the farmers along the way.

Mr. KUIPER: I believe that is true.

Mr. SLOGAN: They have not planned any protection for this area north of the floodway?

Mr. KUIPER: Not that I know of.

Mr. SLOGAN: In the study I noticed that there was mention of the Libau area, where there are several thousand acres which could be reclaimed. Is there any further consideration to diking in this area to prevent flooding from lake Winnipeg.

Mr. KUIPER: Yes. Consideration also was given to diking in the Red river delta and the delta area south of lake Manitoba for flood control purposes, but in both cases it was found the cost of reclamation was well in excess of the value of the land. It would cost $100 per acre to protect land worth maybe $25 or $50 per acre.

Mr. SLOGAN: They planned to go ahead and buy that land from the owner rather than try to reclaim it.

Mr. KUIPER: That is what the government might do.

Mr. SLOGAN: How long a period of time do you think it might be before the need for power in Manitoba doubles?

Mr. KUIPER: Ten years. So if the past trend persists in the future we expect that ten years from now the power demand will be twice what it is today.

Mr. SLOGAN: Can you tell me the relative cost of power per kilowatt hour developed in the Selkirk or Brandon steam generator as compared to the cost of power developed on the Winnipeg river.

Mr. KUIPER: If we had to produce all power by steam the cost would be approximately 10 mills per kilowatt hour. Until recently when all the power was produced by the Winnipeg river the cost was in the order of four or five mills per kilowatt hour; but in the future we will have a mixture of both and the cost will be a compromise between those two extremes.

Mr. SLOGAN: Do you figure the cost at Grand Rapids and the Nelson river will be comparable to that on the Winnipeg river?

Mr. KUIPER: No. The cost will be higher than Winnipeg power but will be less than steam power.

Mr. SLOGAN: Due to the increased distance of transmission I suppose.

Mr. KUIPER: Yes.

Mr. MCFARLANE: Would there be any possibility of putting a power dam on the Red river to act as flood control?

Mr. KUIPER: No sir. The flow of the Red river is too small and unpredictable to make it attractive from a power development standpoint, and there is no possibility of creating a head.

Mr. HICKS: Is there a fish problem here of any kind?

Mr. KUIPER: Not significant. The fisheries department is consulted on all these projects which are proposed. If they feel that fishing is an important problem they propose the installation of fish ladders. If they say so, such works will be installed. So far as I know it was not deemed desirable to have fish ladders and they were not installed.

Mr. HICKS: Could you show us where the Saskatchewan dam hooks into that? I know it is outside the area, but I wondered where it is.

Mr. KUIPER: My sketch so far as the Saskatchewan and Alberta boundary is concerned is a little bit out of order. I would like to correct that a little bit. It is more like this. The south Saskatchewan dam is proposed in this location, and the reservoir which will be created extends some 80 miles upstream. In glacial times, going back 10,000 years, the Saskatchewan river followed the course of the present Qu'Appelle valley and the Assiniboine river. In this location here there is a low saddle where unto which the reservoir will penetrate. So another dam will have to be built here to prevent the water flowing down the Assiniboine river. This gives us the opportunity to release water from the reservoir of the south Saskatchewan dam into the Qu'Appelle river. If there were interprovincial agreements it would be feasible to release more water from the reservoir for the purpose of alleviating low flood conditions on the Assiniboine river further downstream.

Mr. KINDT: Could it be used also for flood control?

Mr. KUIPER: Of what?

Mr. KINDT: Of any of those streams, the north Saskatchewan or the south Saskatchewan. Your series of lakes, I mean, on the Qu'Appelle river?

Mr. KUIPER: You mean these lakes?

Mr. KINDT: Yes.

Mr. KUIPER: Flood control for the Assiniboine situation?

Mr. KINDT: Yes.

Mr. KUIPER: No. The capacity of those lakes is quite small and is already being used for conservation purposes.

There is a large amount of cottage owners and farmlands around those small lakes, so to increase their present capacity would be rather costly, because of the local interest. So I am afraid that is not a practical solution.

Mr. KINDT: In other words, your development there would not be for the purposes of flood control?

Mr. KUIPER: No, not at all. The only purpose it would serve would be water conservation, water supply, on the Qu'Appelle-Assiniboine system.

Mr. SIMPSON: Professor Kuiper, in regard to the Saskatchewan river delta you were mentioning a proposed reclamation area, the Moose lake area.

Mr. KUIPER: Yes.

Mr. SIMPSON: Have you any reason to believe that the Grand rapids power project would eliminate any possibility of reclamation in the Moose lake area?

Mr. KUIPER: No, fortunately not. In the beginning, when the power project was proposed, there were fears from the engineers who were dealing with the reclamation project that to raise Cedar lake about 10 feet above its normal elevation would kind of wash out that whole reclamation scheme. But when a more careful study was made, conducted under the auspices of the Lakes Winnipeg and Manitoba board, and later pursued by the Manitoba hydroelectric board and by the provincial government, it was found that the area that was attractive to reclamation was in the northern part of this delta, and the dikes that had to be built to reclaim that land, if no power project was introduced, would have to be such that when the power project came in, these dikes had only to be raised by a foot in the lower part, and by nothing in the upper part. In other words, the total effect of the power project on the reclamation project is, for practical purposes, insignificant.

Mr. SIMPSON: It will be expected, though, to raise the level of Moose lake proper, I suppose?

Mr. KUIPER: Yes. The present average elevation of Moose lake is approximately 838 and the maximum elevation, under natural circumstances, something like 841; and that maximum elevation may be raised to 844, under the power project.

Mr. SIMPSON: But it would still leave an area to the northeast, possibly, for reclamation purposes?

Mr. KUIPER: Oh, yes. Moose lake, up here, consists of two parts, and the presently proposed development is to have a dam closing off the northern part, separating the northern and southern parts of Moose lake. The southern part would be integrated with Cedar lake to form the reservoir of the power development, and the northern part will be used for reclamation and to store water during high run-off periods. In between there will be a pumping plant which will control the elevation of the northern part of Moose lake. By doing so, the reclamation scheme becomes completely independent of the power scheme.

Mr. SIMPSON: Regarding the proposed power plant at the mouth of the Saskatchewan, what effect is sedimentation going to have on that site; is it going to restrict the useful life of the dam?

Mr. KUIPER: The total volume of the storage reservoir on Grand rapids is in the order of magnitude of 7 million acre feet. The total sediment content on the Saskatchewan river is 12,000 acre feet per year, on the average. Out of that 12,000 acre feet of sediment that the Saskatchewan carries during the year, most of it is deposited west of The Pas in the lake delta and in the Sipanok area. So let us say that approximately 4,000 acre feet reaches Cedar lake and is deposited in Cedar lake. You will appreciate that 4,000 acre feet per year does not make a significant problem; in view of the total storage capacity of 7 million.

Mr. KINDT: Mr. Chairman, I have the same question, concerning sedimentation on the Saskatchewan dam. At the present time, with all the land under cultivation, is it your thought that sedimentation is far greater now than it was before the white man came?

Mr. KUIPER: This answer must be a matter of speculation, because we have no facts to back it up. In some areas the answer must be unconditionally yes. If the land is abused, the natural vegetation destroyed and erosion invited by removing the natural vegetation, in such cases it will undoubtedly bring more sediment contribution to the river system than there was before. But in other cases I think the use of the land, proper agricultural use, might have reduced the sediment contribution. If you balance the one against the other, I would say—again, I would speculate—that presently there might be more sediment in the river system than there was before the white man came.

Mr. KINDT: In other words, the entire problem of soil conservation is envisaged in preventing the eroding of top soil?

Mr. KUIPER: Yes.

Mr. KINDT: And up until now, very little has been done in western Canada on the question of soil conservation.

Mr. KUIPER: Right.

Mr. KINDT: In other words, that is an entire field which we have to get into some day?

Mr. KUIPER: Yes.

Mr. KINDT: Both from the point of view of the prevention of sediment, and from the point of view of structures, dams, and so forth, as well as keeping the top soil on the land, where it should be, for the use of growing crops for future generations?

Mr. KUIPER: Right. Mind you, this problem is somewhat removed from the problem of developing water resources. Often it is thought we could link these two together, and go to soil conservation schemes as part of the water resources development program.

Mr. KINDT: The two are tied together.

Mr. KUIPER: I was going to suggest they do not tie together so closely because in regard to the contribution for the purpose of water resources development, it is estimated to be cheaper to control the water by building a reservoir than by proper land use. The thought is that from a benefit cost viewpoint, you would build a reservoir. However, you might be right in saying that the proper way to do it is by proper land use measures. These measures are much more expensive, though. If you wished to control flood control by small reservoirs and proper use of the land, you would have to allocate about 90, 95 or 99 per cent of that cost to use of the land, and not to water resources development. This cost is a much different order of magnitude than building reservoirs for controlling the flood for downstream purposes.

The CHAIRMAN: Have you a question, Mr. Slogan?

Mr. SLOGAN: I would like to revert to the Red river. The United States has conducted certain surveys in their area of the Red river, constructed certain dams, and instituted certain drainage projects. Have the total of these projects increased or decreased the amount of water flowing across the border at Emerson?

Mr. KUIPER: That answer, again, must be a matter of speculation, since there is no reliable data on which to fall back in connection with how it was in the early days. However, I would say that part of the projects in the United States have been slightly detrimental to us, because of the existence of drainage basins, thereby making the water run off faster toward the main stem of the river system. On the other hand, they have built dams and reservoirs, which hold back the water. I would say, on balance, if there is any balance at all, plus or minus, it is rather insignificant, in so far as the Winnipeg flood control, as a whole, is concerned.

Mr. SLOGAN: What is the average total amount of water that comes over at Emerson?

Mr. KUIPER: In 1950, it was close to 90,000 cfs.

Mr. SLOGAN: The amount of water going into the United States has a very significant impact on the flood situation in Winnipeg.

Mr. KUIPER: Yes.

Mr. SLOGAN: In regard to the floodway, there were two proposals—the original, and the revised plan. Which one was adopted?

Mr. KUIPER: I do not think any plan has been adopted finally. The plans that are in existence now are still under negotiation.

Mr. SLOGAN: Are they considering the extension that was proposed, to take in St. Norbert?

Mr. KUIPER: It is being considered as well, but no decision has been made in that regard.

Mr. SLOGAN: When the floodway is built, there are three proposals—25,000 cfs, 40,000 cfs and 60,000 cfs. Which one of these is recommended?

Mr. KUIPER: I believe 60,000 cfs, in conjunction with the 25,000cfs Portage diversion. That was the finding of the royal commission.

Mr. SLOGAN: When this floodway is built, the earth that is going to be removed will be held back with dikes; is any provision made for drainage into this floodway, along this route, or is it going to be blocked off?

Mr. KUIPER: I am sure that if no provision has been made yet, in the final plans it will be made.

Mr. SLOGAN: They could put in lock culverts.

Mr. KUIPER: Yes.

Mr. SLOGAN: Could you give us a more physical description of that floodway? How wide, and how deep is it?

Mr. KUIPER: The bottom width of the floodway will be approximately 500 feet. However, this is one of the present proposals, and it may be changed. The depth of excavation, below existing ground level, varies as to whether you are in the middle or lower part. Let us say this is in the magnitude of 20, 30 or up to 40 feet. It will range from three to one to six to one, depending on the soil condition in this or that part of the course. The total amount of excavation is in the order of magnitude of 100 million cubic yards. So, even from an international point of view, this is a major excavation project.

Mr. SLOGAN: How big will it be where it enters the Red river, below the the locks—below the level of the earth?

Mr. KUIPER: I could not tell you, offhand.

The CHAIRMAN: Have you a question, Mr. Simpson?

Mr. SIMPSON: Is that planned to be simply an excavation project, or is any part of it going to be built up?

Mr. KUIPER: No, it is mostly excavation.

The CHAIRMAN: The velocity is not such that it is going to have to be lined with rip-rap or concrete?

Mr. KUIPER: No. One of the engineering problem is to keep the velocities below eroding capacity. Such a grading will be maintained so that the velocity is below, say five feet per second, so no erosion takes place. And, to maintain that radius, it is possible to build a drop structure at the lower end of the diversion.

Mr. SLOGAN: Could the water from the floodway be used for irrigation purposes, if that was necessary, in the area through which it is passing?

Mr. KUIPER: Well, the floodway will be used during the times when you would not want irrigation.

Mr. SLOGAN: Would it not have a normal flow through it at all times?

Mr. KUIPER: No; it will be used only during flood times on the Red river —and in those times, there will be little need for irrigation.

Mr. SLOGAN: The floodway is going to be cutting across a great number of farms. Is any provision being made for them? What sort of bridge facilities will there be along the floodway?

Mr. KUIPER: There will be a number of bridges for highway and railroad traffic. Offhand, I do not know the exact total. We will say, in the order of magnitude of five railroad bridges and five highway bridges. This ditch is much too large to accommodate local farmers with local bridges.

Mr. SLOGAN: In other words, if it goes across a farmer's land, he may have to travel ten to fifteen miles to get to the other end of his farm?

Mr. KUIPER: I think a better solution might be that an exchange of land takes place so that one farmer only owns land on one side of the ditch and the other farmer owns land on the opposite side.

THE CHAIRMAN: You are next, Dr. Kindt.

Mr. KINDT: If the sites along the Nelson river were to be developed there would be such a tremendous production of electric energy and power that the problem would probably then shift to transmission of power and the loss in transmission.

I have one further thought: if that loss could be reduced technically, it might bring about greater development along the Nelson river and increase the shed to which that electric power should be transmitted. Do you agree with that?

Mr. KUIPER: I agree. That is correct. That is a sound thought. The loss of energy and capacity from transmitting power from these sites to Winnipeg is in the order of magnitude of five per cent. And assuming extra high voltage, transmission loss would be in the order of from 400 to 500 megawatts.

By any power which you consume locally would not have that transmission loss problem, and would therefore be quite attractive. In fact, the lines from the rapids which you saw in the last slides—we have made a tentative that if all these engineering developments are as favourable as we hope they are, then power could be produced locally for about three mills per kilowatt hour. That is a price at which metallurgical processing companies might become interested in building plants on site, such as refinery and processing plants; and if suitable ore bodies were found in this general vicinity, power at three mills per kilowatt hour might tempt them to process it there on a larger scale than is being done at the present time on the Thompson.

You are quite right in assuming that if you develop this power demand in Manitoba, you will incidentally and quite importantly stimulate development in northern Manitoba, especially if you can make a large amount of power available at low rates. You could sell power here much cheaper than you could sell it here.

THE CHAIRMAN: You spoke about the possibility of improvements in the transmission of power and of lowering the present losses. Do you foresee any advance in that connection in the near future?

Mr. KUIPER: Well, the state of technology on the North American continent as far as the transmission of power is concerned is mostly based on alternating current and on extra high voltage, which has been considered as high as from 400 to 800 k.v. The loss of power capacity when transmitted for distances like these of from 400 to 600 miles, is in the order of magnitude of five per cent.

The Russians are experimenting on large scale transmission of power over large distances, but they use direct current; and it is reported that thereby have reduced their losses consequently. Technologically speaking, it is quite a problem to convert alternating current into direct current and then back again from direct current into alternating current. It seems that on the North American continent we are not as far advanced in this technology as they are in Russia, with the result that we do not consider this possibility seriously here, whereas they are going ahead and constructing direct current lines in Russia.

Whether that technology will be available here, or whether we can work it out independently, I do not know. But there is a possibility of bringing about the transmission of power and making it less expensive than it is now.

Mr. SIMPSON: In connection with the development of various power plants on the Nelson, is it absolutely necessary to have separate transmission power lines from each of those plants?

Mr. KUIPER: Oh no. You would come together with your transmission lines from these cities, a dozen plants, to the common point, and from there to Winnipeg via six lines, as you need them. The ultimate development, for some 4,000 megawatts would be 5 lines; five 460 kv lines.

Mr. SIMPSON: Would you assume development of Grand rapids is going, eventually, to assist in bringing additional power from the Nelson river area?

Mr. KUIPER: Yes.

Mr. SIMPSON: Would it be cheaper developed power in the Nelson river after Grand rapids is constructed than if it was gone ahead with?

Mr. KUIPER: That is correct, particularly in the early stages of the Nelson river development. For 5 to 10 years we will have a situation, with the Grand rapids fully developed and transmission lines extending from Grand rapids to Winnipeg; and in the preliminary stages of the Nelson river development they can make part use of the existence of the Grand rapids to Winnipeg lines. As I say, ultimately we will have 4,000 megawatts here, and 300 here. You will appreciate that by that time this stage of the program becomes insignificant. Looking 22 to 30 years down the road Grand rapids is of very little concern. But in the early development, somewhere around '70 to '75, it will be a great advantage to have Grand rapids with its transmission lines in place.

The CHAIRMAN: Gentlemen, it is after 1 o'clock.

Mr. SIMPSON: In regard to the reclamation area for the Pasquia project, I think you mentioned a figure of $25 an acre on the reclamation project. Inside the reclamation area we have the drainage ditches from the existing small lakes that are in there. When you were referring to the $25 was that on the irrigation drainage ditches or dyking?

Mr. KUIPER: That includes the dykes up to proper elevation and main canals for drainage. So, in the Pasquia area, if this is the Pasquia area, let us say, the main canal here, with a couple of main features like this; that is included in the $25. Before you can fully make the land available to potential farmers you need more drains and highways, and then you can say to the farmer, "Here is the land; go ahead and farm it." That additional cost, I will guess, is part of the $25—less than the $25. It may bring the total development to $30.

Mr. SIMPSON: You referred also to that $25 in relation to other places costing two, three and four hundred dollars up to $2,000?

Mr. KUIPER: Yes, that is the irrigation process.

Mr. SIMPSON: Are there other areas in Canada that run that high?

Mr. KUIPER: If we take the South Saskatchewan reclamation project, for instance, the intentions are to develop, approximately, ½ million acres for irrigation purposes; and the total cost to be allocated to irrigation—and you may know better than I do—is in the order of $90 million to $100 million, or $120 million, depending on how much you allocate for power. Let us take a figure of 100. With a half a million acres and $100 million, that is roughly $200 an acre.

It is not the same problem. You do something different in an area where people live already, and improve the land by bringing water on to the land. So you increase crop production here in the delta area. So you accomplish making land suitable for successful agriculture.

The CHAIRMAN: What area is involved approximately in these two reclamation projects?

Mr. KUIPER: The total potential area of reclamation in the Saskatchewan delta with the Sipanok area, plus the Pasquia area and the Moose lake area is in the order of 1 million acres.

The CHAIRMAN: What was your official capacity on the lakes Winnipeg and Manitoba board?

Mr. KUIPER: I was the chief engineer of the board.

The CHAIRMAN: Is there any cooperation or coordination between this board and a similar board in Saskatchewan?

Mr. KUIPER: There was not at that time.

The CHAIRMAN: Anything that might be done in Saskatchewan or Alberta in the upper section of the river could effect development in the lower reaches of it and there is no coordination between the provinces.

Mr. KUIPER: I would not go that far. There is the prairie provinces waters board which considers the mutual water engineering problems which exist in the three provinces. I understood your first question to be did the lakes Manitoba and Winnipeg board have any contact with similar organizations in Saskatchewan.

Mr. SLOGAN: Were there any members of the prairie farm rehabilitation board acting on this board?

Mr. KUIPER: No. The only connection is that before I joined the lakes Winnipeg and Manitoba board I came from the P.F.R.A.

Mr. SLOGAN: There were no federal engineers on that board?

Mr. KUIPER: Yes. There were two from the Department of Northern Affairs and National Resources, Mr. Patterson and Mr. May.

Mr. SLOGAN: In respect of the flood problem on the Red river and a lot of other streams from ice jams, is all this going to prevent ice jams, or were there other steps being taken, or will it be just as bad as it was before.

Mr. KUIPER: The flood problem in greater Winnipeg is not primarily a problem of ice jams. Admittedly, during the early breakup sometimes there are ice jams on the Red river, but the extreme periods in 1950, 1916, and going back in history to 1861, 1852, and 1826, were all caused after the ice jams were over when there was a large amount of runoff which came from the prairies into the river system and the levels were many feet higher than during the preceding ice jams.

Mr. SIMPSON: Do you feel that the diversion of Portage la Prairie and lake Manitoba would more or less solve a majority of the problems in respect of the flooding of the Assiniboine river in the more populated areas? Do they not have flood problems in respect of irrigated farm lands above that?

Mr. KUIPER: The virtue of the Assiniboine river diversion is to protect the farmers between Portage and Winnipeg from flooding and to make a significant contribution in the flood situation at Winnipeg. Of course it would mean nothing to the people in the Assiniboine river valley upstream from Portage.

Mr. SIMPSON: Are most of the problems of the Assiniboine flooding between Portage and Winnipeg or are they upstream?

Mr. KUIPER: To express it quantitatively, I would say yes, most of the problems are between Winnipeg and Portage. But we should not neglect at all the other problems that exist upstream around the city of Brandon, where some of the outskirts have protruded into the valley, and between Brandon and St. Lazare.

You saw one picture of the whole of the Assiniboine flooded. There is a significant problem during the years with the Assiniboine river. But more significant is the flooding of the land of Portage to Winnipeg. When the Assiniboine river floods, the water has a large plain to flow over, because the plains east of Portage la Prairie have been formed by dissipation. The river system has raised the land and flows on top of a self-formed ridge. As soon as the water comes out, the water on top of the ridge flows down, stops and disperses over all the land, and thousands of acres flood. Most of the water does not get back to the river. Some does, through minor creeks; but most is dissipated to the north, to Lake Manitoba, and to the south and southeast towards the Red river. So far, from a statistical viewpoint, we are rather fortunate that the floods on the Assiniboine river have been relatively small, 20,000, or 25,000 cfs. We have had dozens in the last few years. When you approach the problem from a statistical viewpoint, you can expect that once in 50 years it is not an unusual event to have a flood of 40,000 cfs, instead of 20,000; twice as much as has been experienced.

When a flood such as that comes down the Assiniboine river, you have breach after breach in the present diking system, and the land will be flooded to a great extent. The tendency of people, when land is flooded, is first "Let us stick it out in our own house and see what it will be like". Then soon the water level comes up so high that they cannot get supplies in, and so on, and they want to flee to higher land at that time. They are surrounded by miles and miles of water. They try to flee. Somewhere they find a breach in the road, without noticing it, and down they go.

I am afraid that when a large flood comes on the Assiniboine, and the flood control situation is in the same shape as it is now—namely, dikes up to 20,000 cfs, and no protection above that—there could be a significant disaster between Portage and Winnipeg. One way to contribute to the flood control situation is the Assiniboine diversion—and a very efficient one.

Mr. Kindt: What would be the length of that diversion?

Mr. Kuiper: About 15 miles from Portage to Lake Manitoba, with an estimated cost of about $10 million.

The Chairman: I want to thank the committee members for sticking it out here until we got a quorum; and I also want to thank Professor Kuiper for the wonderful outline he has given us of water problems in Manitoba. I am sure that some of those who did not get here to the meeting really missed a worth-while presentation.

I just want to remind the committee that tomorrow we have Mr. Cass-Beggs and Mr. MacNeill from Saskatchewan to speak on the Saskatchewan problems. So we will probably be reaching down a bit into Manitoba again from Saskatchewan. Thank you very much, Professor Kuiper.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 15

TUESDAY, MAY 31, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESSES:

Mr. J. W. McNeill, Executive Director, South Saskatchewan River Development Commission; and Mr. D. Cass-Beggs, General Manager, Saskatchewan Power Corporation.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23215-7—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, May 31, 1960.
(16)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Fleming (*Okanagan-Revelstoke*), Godin, Gundlock, Hicks, Kindt, Leduc, McFarlane, McGregor, McQuillan, Payne, Simpson, Slogan and Stearns—(13).

*In attendance:* Mr. J. W. McNeill, Executive Director, South Saskatchewan River Development Commission; Mr. D. Cass-Beggs, General Manager, Saskatchewan Power Corporation. *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; and R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Messrs. McNeill and Cass-Beggs to the members of the Committee.

On motion of Mr. Payne, seconded by Mr. Simpson,

*Resolved,*—That the Committee authorize payment of expenses incurred by Mr. E. Kuiper of the University of Manitoba, who appeared before the Committee on May 30th.

The Chairman called Mr. McNeill who read a prepared brief dealing with the objectives and responsibilities of The South Saskatchewan River Development Commission. Copies of this brief were distributed to the members of the Committee.

The Chairman then called Mr. Cass-Beggs.

*Agreed,*—That the brief prepared by Mr. Cass-Beggs dealing with hydroelectric development in the province of Saskatchewan including reference to the possibilities of inter-connection with utilities in neighbouring provinces, be taken as read and included in this day's evidence. Copies of this brief were also distributed to the members of the Committee.

Mr. Cass-Beggs summarized his brief and was questioned together with Mr. McNeill.

Mr. Côté, Assistant Deputy Minister, made a statement dealing with water gauging stations in Canada, snow surveys and sedimentation surveys.

At 11.30 a.m., the Committee adjourned until 9.30 a.m. Monday, June 6.

M. Slack,
*Clerk of the Committee.*



23215-7—1½

# EVIDENCE

TUESDAY, May 31, 1960.

The CHAIRMAN: We have a quorum gentlemen. I call the meeting to order.

First, I would like to introduce to you the witnesses whom we have with us today. Immediately to my right is Mr. J. W. McNeill, executive director, South Saskatchewan river development commission, Regina, Saskatchewan. Then to his right is Mr. D. Cass-Beggs, general manager of the Saskatchewan power corporation.

Mr. McNeill will present his brief first of which we have already distributed copies to you. Then Mr. Cass-Beggs will endeavour to cover the second brief. If there is not sufficient time, we might ask him to summarize it, and then have the brief incorporated in the minutes as read, in order to leave some time for questioning.

There is one item of business I would like to deal with first, however. Yesterday, as you know, we had Professor Kuiper appear before us. Professor Kuiper had come at our invitation, but at his own expense; and I feel we should authorize the reimbursement of his expenses, if somebody in the committee will so move.

Mr. PAYNE: I so move.

Mr. SIMPSON: Seconded.

Motion agreed to.

The CHAIRMAN: Now, Mr. McNeill, would you proceed, please, to present your brief?

Mr. J. W. MCNEILL (*Executive Director, South Saskatchewan River Development Commission*): Thank you, Mr. Chairman.

The South Saskatchewan river development commission is pleased to have this opportunity to present some of its views on water resource development to the House of Commons committee on mines, forests and waters. In his invitation, your chairman explained that this year you propose to consider the development and use of Canada's water resources in some detail, and he suggested that you would be interested in an outline of the objectives and responsibilities of our newly established commission, and some of the problems confronting us in planning the development and use of the South Saskatchewan river. This is a very large task. However, during the next half-hour I shall try to present a brief picture of the administrative and organization problem that faced the government of Saskatchewan when the South Saskatchewan project agreement was signed, which led to the establishment of the new South Saskatchewan river development commission. After a general description of the objectives and role of the commission, I would like to mention a few of the problems that are now or soon will be confronting us in planning the future development and use of this great resource. Some of these problems will require inter-provincial and federal co-operation to resolve. Later, Mr. Cass-Beggs will be outlining our current thinking with respect to the development of the tremendous hydro resources of the Saskatchewan river, which I am sure you will find most interesting.

### I. *The South Saskatchewan Project Agreement*

As members of the committee know, the federal and provincial governments reached agreement to proceed with the South Saskatchewan project nearly two years ago. In broad terms, the agreement signed on July 25, 1958, provided that Canada would be responsible for the design and construction of the reservoir, including the two huge earth-filled dams and certain related works. The cost of the reservoir, estimated at $96.0 million, was to be shared 75 per cent by Canada and 25 per cent by Saskatchewan.

The province was made solely responsible for planning and developing the multiple benefits of this new water resource; the irrigation of an estimated 500,000 acres, power facilities to generate approximately 500 million KW-hrs. annually, the recreation development of some 500 miles of shoreline, water supply to cities and towns, and so on. The cost of developing only the irrigation and power benefits of the reservoir is estimated, some say optimistically, at $94.0 million.

This statement needs to be qualified only insofar as the rate of developing the irrigation project and the cost of the power facilities are concerned. The province committed itself to complete facilities for the full irrigation of 50,000 acres within a year after the reservoir was filled. Because of the extreme length of the tunnels required initially to divert the river during the construction of the dam, and later to convey water from the reservoir to the turbines, the federal government agreed to contribute 25 per cent of the cost of constructing and installing steel penstocks up to the size and capacity required to produce 200,000 horsepower at minimum head. The federal contribution will amount to about $2.0 million, or approximately 4 per cent of the cost of the power facilities.

The agreement also stipulated that on completion of the reservoir, the province would assume immediate responsibility for its operation, and ten years later, for its maintenance. In addition, the province was required to undertake a number of tasks related to the construction of the reservoir; for example, the relocation of roads, ferries, bridges, power and telephone lines in the area to be flooded.

### II. *The South Saskatchewan River Development Commission*

After the agreement was signed, it was evident that either one or several provincial agencies would have to be made responsible for work in four main areas. First of all, policies and plans for each benefit phase of the project would have to be developed. Secondly, these policies and plans would have to be approved and coordinated, both within the provincial administration and between the three levels of government involved; federal, provincial and municipal. Although the latter are not referred to specifically in the agreement, it was realized that the project would have a tremendous impact on the services provided by local governments in the area, and that they would require the advice and assistance of the senior governments. Thirdly, the approved plans would have to be implemented, and the resulting construction activity would have to be closely coordinated. Finally, some agency would have to be responsible for the allocation of reservoir water between the various potential users, and for the operational management and maintenance of the reservoir.

The administrative organization that has been established to assume these functions is unique in many respects. In other jurisdictions several forms have been adopted to meet similar problems of water resource development. These range from formal inter-agency committees responsible for coordination within and between government jurisdictions, to large regional authorities fully responsible for all the phases of water resource development within a designated area. Each has its advantages.

In this case the government attempted to conceive an organization that would achieve the highest degree of inter-agency coordination compatible with a minimum duplication of existing technical and administrative resources, and a minimum disruption of the existing administrative framework. Thus our Department of Agriculture was made responsible for originating plans for the irrigation development, and for the implementation of the plans once they are approved. In a like manner the Saskatchewan power corporation is responsible for the power development, and the Department of Natural Resources for the recreation development. A new seven-member, semi-independent South Saskatchewan river development commission was established and made responsible for guiding the overall development of the project, for the approval and coordination of the policies and plans originated by the operating or program departments, for coordination between the three levels of government, for the operational management of the reservoir and for the resolution of any conflicts that might arise in the allocation and use of water.

The bill to establish the commission was adopted by the legislature in March, 1959; and six of the seven members and the nucleus of the secretariat were appointed in August of last year. As a result, the organization, policies and plans of the commission are only now beginning to take shape. Its precise role in the development will not come into sharp focus until we have had considerably more experience and dealt with a larger number of concrete problems.

Under the act, the commission is required to advise the government on all aspects of the research, planning and development required to achieve the optimum utilization of the project. It must also consult with and advise all government agencies on their duties and responsibilities. If no agency exists or is equipped to undertake certain duties, the commission may recommend the establishment of a new agency or undertake the work itself.

In addition to this general advisory function, the commission is required not only to coordinate, but to approve the policies and plans of the separate line agencies before they are recommended to the government. It must also effect liaison and coordination between the province and federal and municipal governments.

Subject to the general statutes of the province, and inter-provincial agreements, the commission was granted exclusive jurisdiction over the allocation of reservoir water between irrigation, power, recreation, municipal and riparian interests, and for levying charges for the use of this water. On completion of the reservoir, it will be responsible for its operation, and eventually, its maintenance.

Although the act gives the commission other duties, more or less of a specific nature, these are the more important. They may be added to from time to time by government directive.

Having given it these responsibilities, the government intended that the commission should have sufficient power and status to carry them out. It is a semi-independent agency, with both public and government representation, and is responsible directly to the premier of the province. It may require plans, reports, and information from all departments and agencies, secure technical advice and assistance from them, and appoint committees and consultants. It has special powers respecting land use control in the project area, and may acquire and expropriate lands and minerals.

## III. *Planning the South Saskatchewan Project*

During the past 18 months research, planning and preliminary design of the major projects benefits has proceeded within this administrative framework. Time will not permit me to do more than mention a few of the many fields within which we have been working.

The main purpose of the project is irrigation, and it is estimated over 500,000 acres can ultimately be served with water. As a first step in launching this phase of the project, the province has agreed to have facilities for the irrigation of 50,000 acres completed a year after the reservoir is filled, which we expect will be the fall of 1966 or 1967. The selection of this acreage will be determined partly on the results of an economic classification of the irrigable land, partly by the comparative cost of serving alternative areas, and partly by the attitudes of the farmers concerned. Work on the irrigable land classification, preliminary design of the irrigation system, and studies basic to framing a land policy is proceeding rapidly and we hope that the initial acreage will be selected by the spring or summer of 1963.

As Mr. Cass-Beggs will be outlining in some detail, plans for the first stage of the power development at the main dam south of Outlook have been fairly well determined. This plant is scheduled for completion in 1966 and will be capable of generating over 500 million KW-hrs. in an average year. While this is important, our current investigations of hydro sites between the main dam at Coteau creek and the Manitoba boundary suggest that it is not nearly as significant as the potential downstream power benefits of the immense storage in the reservoir.

The reservoir, with its 500 miles of shoreline, is situated in a part of Saskatchewan suffering from a shortage of outdoor recreation areas, and those that exist are badly overcrowded. Realizing its critical location in this regard, last fall we engaged a consultant to undertake a comprehensive study of the recreation resources of the reservoir, and to recommend an over-all plan for their development. Although his study will not be completed for several months, preliminary reports indicate that there will be several sites suitable for development as provincial and regional parks, institutional camp sites, and wildlife reserves. Fishing should be excellent. In time, with careful planning and controlled development, this reservoir will become a major beauty spot in the arid prairie area of western Canada.

We have also begun studies to determine the extent of diversion into the Qu'Appelle basin, existing and future land use in the project area, the future water needs of communities adjacent to the Saskatchewan and Qu'Appelle, and the best method of operating the reservoir.

### IV. *The Need for Inter-provincial Planning and Coordination*

In planning the development and utilization, not only of the South Saskatchewan reservoir, but also of the many sites downstream and on the north branch, we have to bear in mind that this river, like so many others within our province, is a part of an inter-provincial system. At least three provincial governments, the federal government, and several urban centres, as well as a number of private power and wildlife groups, are concerned in one way or another in its future development and operation.

It has been long recognized that the multi-purpose development of our water resources should be planned on a regional basis, and that the river basin is the natural unit for such planning. It is the natural unit within which climate, rainfall, geology, topography, drainage patterns, stream flow, watershed management, erosion and sedimentation are inter-related. It is the natural unit within which to study those fields of economic and social activity which give rise to the needs to be met by water development—needs for irrigation, power, municipal supplies, industrial processes, flood control, recreation, wildlife, pollution abatement and so on. It is the natural unit within which to plan the development of a river. For example, headwater storage on the North Saskatchewan may provide power for Alberta, pollution abatement at Edmonton which would improve the quality of municipal water at Prince Albert and

other communities in Saskatchewan, and increase the power potential of hydro sites and installations in Saskatchewan and Manitoba. A large new irrigation development in southern Alberta would reduce the amount of water available for consumptive and non-consumptive uses in Saskatchewan and Manitoba. However, it may be possible to compensate for this by the diversion of Athabaska or Churchill water into the Saskatchewan system. The imminent diversion of some South Saskatchewan water into the Qu'Appelle-Assiniboine system will influence development in both Saskatchewan and Manitoba.

The preparation of a comprehensive, multi-purpose and integrated plan for the development of the Saskatchewan-Nelson basin is an urgent necessity if we are to realize the full potential of this great system and avoid fragmented and perhaps conflicting development. Such a plan should be adapted to the resources, growth potential and future water needs of each of the provinces and communities in the basin, and should include local and provincial as well as federal and joint undertakings. Given the fact of provincial sovereignty over water resources, it must seek to achieve a mutual and relatively equal sharing of benefits among the three prairie provinces. The plan need not be in complete detail initially, but it should provide a framework into which specific projects and programs can be fitted, and against which their relative benefits and disbenefits can be measured as they are further developed.

At the moment the only federal-provincial group available to undertake and direct this work is the prairie provinces water board. It was established in 1948 by the governments of Canada, Manitoba, Saskatchewan and Alberta, and consists of two members appointed by Canada and one from each of the three provinces. The board's general function is to recommend the best use to be made of inter-provincial waters in relation to associated resources in the three prairie provinces and to recommend the allocation of water between them. The board's recommendations must be approved by each of the four governments party to the agreement before they are effective.

This board has been successful in resolving the few conflicts of interest that have arisen to date between the three provinces on the allocation and use of inter-provincial waters, and a large number of useful studies have been made under its auspices. However, I think it is generally conceded that the Board has been handicapped in its work, particularly in recommending the best use to be made of common waters, by the lack of an ultimate development plan. Last December, the board agreed to prepare terms of reference outlining a program of study of the physical aspects of an integrated basin plan of the Saskatchewan-Nelson system, indicating the portions of this study already completed or under way by agencies of the federal or provincial governments, and recommending ways and means to undertake the study. The government of Saskatchewan has expressed its full support of this study and should it be proceeded with we hope that the necessary funds for administration and staff will be made available.

## V. *The Need for Basic Data*

The preparation of sound plans for the development and operation of our water resources requires a tremendous array of current and historical data in a wide range of specialized fields—physical, chemical, biological and socio-economic. Again, the river basin is the natural unit within which to collect, analyse and interpret much of this data.

I think it is generally conceded at the present time we simply do not have, nor are we collecting, enough information in all fields to ensure the optimum development of our water and associated resources. This is probably due more to a shortage of specialized staff and a lack of funds than to a failure on the part of government to appreciate the vital necessity of adequate data.

During the past several years, both federal and provincial agencies have taken steps to coordinate and expand their basic information programs. While considerable progress has been made, further expansion of these programs is necessary if we are to meet the growing water requirements of an increasing population and industry.

I do not have the time, nor am I competent, to discuss this question in great detail, but I would like to draw your attention to a few areas in which the failure to collect ample data over the past several years is making it difficult to plan the development and operation of the south Saskatchewan reservoir.

One of the more immediate questions facing us is how best to plan the future development of property adjacent to the reservoir shoreline. What specific areas should be zoned and reserved for urban development, recreation use, afforestation and agricultural use? Where can we safely locate roads and other services? Many factors will have to be considered, of course, but one of the most critical determinants is the anticipated location, form, and rate of growth of deltas in the headwaters, at the junction of tributaries, and the general distribution of sediment throughout the reservoir. The deposition of silt in the reservoir, particularly in the headwaters, can result in a significant increase in backwater elevations, which in turn can endanger upstream installations and developments like bridges and water-intake works. It also has a bearing on the development of the shoreline for recreation, suitable sites for which are often found at the junction of tributaries and around harbours and bends in the river subject to aggradation and degradation.

Techniques have been developed to predict the distribution of sediment, but their usefulness depends upon the amount of historical data available on stream flow and sediment load. Although the records of stream flow on the south Saskatchewan go back some 47 years, there is very little information available on sediment load. This factor has been measured at only one station on the river for a period of about ten years. In view of this, our proposed study of sediment distribution will have to rely heavily on judgment and on correlations with reservoirs in other watersheds.

With the prospect of additional reservoirs being constructed on both branches and the main stem of the Saskatchewan river, there is an urgent need for a large increase in the number of sediment gauging stations. Stations should be established at key points along the main branches, and at the junction of each of the major tributaries. This information is essential both to predict the useful life of reservoirs and the distribution of sediment in them. It would also assist in determining the major sources of the sediment, and to plan corrective measures such as improved watershed management.

Another question that will concern us shortly is the allocation of reservoir water for a number of purposes, including municipal water supply. Clearly, if we are to achieve the best use of our surface waters, especially for municipal and industrial use, we must have adequate information concerning alternative sources of water for each community, particularly groundwater resources. This is another case where lack of sufficient data could result in erroneous or unwise decisions.

Fortunately, a heightened interest in groundwater resources is now evident in Saskatchewan. More and more urban centres are seeking adequate and economic sources of water for both new and expanding systems. This interest has been stimulated recently by programs introduced by the province to assist the smaller communities with the construction and financing of modern sewer and water facilities. A reconnaissance survey has already been carried out to assess the future needs of all urban communities with a population of 500 or more, excepting the major cities, and to assess the possible location of adequate supplies. Preliminary studies have also been made of the comparative economics

of utilizing local wells as against relying upon extensive inter-municipal pipeline systems carrying water from dependable, but relatively distant, surface sources. On the whole these studies tend to show that at prospective levels of consumption and cost, important economies can be achieved for most centres if adequate supplies of potable groundwater can be discovered and developed.

Further, the province has recently initiated an extensive program of helping farmers in the modernization of farm homes. Technical aid and financial grants have been made available to assist in the installation of running water for domestic and farm use. Because of the sparse pattern of farm settlement the vast majority of these installations will be dependent upon the adequacy of farm wells, cistern storage, or dugouts for trapping surface run-off.

As a partial answer to the need for more information concerning groundwater the provincial research council has undertaken a program of reconnaissance surveys to assess the pleistocene geology and groundwater probabilities. It is proposed to map the entire settled portion of the province as rapidly as finances and resources of skilled personnel will permit. As the mapping locates possible aquifers of major importance, these will be explored by geophysical methods and test drilling.

The geological survey of Canada is co-operating with the provincial research council in these investigations, and they are coordinating their work with the research council to expedite the program and to avoid duplication of effort. In view of the pressing need for this information, we hope that their efforts will be continued and intensified. I understand that as the investigations in specific areas are completed, reports and maps will be published and made available to the public.

A less immediate but equally important question is how to operate the reservoir in order to achieve the maximum utilization of reservoir storage and river flows. Obviously the successful operation of a single multi-purpose reservoir for irrigation, power, recreation and other uses, or the operation of an integrated system of reservoirs, requires reliable daily, weekly, monthly, and even longer-term forecasts of the volume and intensity of stream flow. If watershed conditions indicate a drought, storage must be maintained at a maximum so that established services will function through the low-flow period. On the other hand, if high flows are forecast, reservoirs may be drawn down to accommodate the expected inflow. Failure or inability to forecast accurately may result either in deficiencies during an unexpected low flow period, or excess spillage during a high flow period with a consequent loss in potential power revenue.

The Saskatchewan river derives most of its flow from the eastern slopes of the Rockies, and a basic forecasting program must deal mainly with conditions in the mountains and foothill watershed. With the prospect of a number of new multi-purpose and hydro reservoirs on the Saskatchewan river, programs to collect data for a basic forecasting service should be extended now. Although a detailed study will be necessary before precise recommendations can be made, it is very probable that the following programs will have to be extended:

(*a*) Stream gauging—to provide the basis for estimates of maximum, mean and minimum flows. This program is deficient in two respects; there are not enough stations in many sections of the watershed, and there are not enough records that have been continuous over a long period of years. In 1952, the average coverage per stream gauging station in the Saskatchewan River Basin was 1,650 square miles, compared to the USA's 960 square miles, France's 210 square miles, and Italy's 90 square miles.

I believe you may have received more up-to-date information on the density on these gauging stations.

(b) Snow surveys—to determine the depth, water content and density of the snow, and enable an estimate of the total volume of run-off. At present, I understand that only two regular courses are being run; one on the Bow river watershed and one on the St. Mary's. These should be extended to the tributaries of both branches of the river.

(c) Meteorological stations—several high altitude stations should be set up and operated over a period of years to enable an analysis of the effect of meteorological conditions on snow melt, and predictions of the rate of run-off.

(d) Basic studies to determine the ratio of runoff-rate to rainfall. This information is needed over the entire basin so that long-term weather forecasts can be converted into stream flow. In order to obtain this ratio considerable work must be done to determine infiltration, surface detention, and evaporation and transpiration rates in different regions of the watershed.

The Department of Northern Affairs and National Resources is responsible for collecting and publishing most of the information mentioned above. For the past several years, stream gauging stations have been operated by this department under cost-sharing agreements with the provinces. I believe it has been suggested that the same arrangement should apply for sediment measurement stations.

During the next year we propose to undertake a study of existing data collection programs in the Saskatchewan river basin, and bring forward recommendations as to where they should be extended. We trust that funds will be made available to establish and operate new stations where necessary.

The CHAIRMAN: Thank you very much, Mr. McNeill.

Mr. MCNEILL: I think, Mr. Chairman, that a lot of the questions which members of the committee may have with respect to my brief will be answered in Mr. Cass-Beggs' presentation.

The CHAIRMAN: Then we shall ask Mr. Cass-Beggs to go ahead with his brief and see what progress we make with it. I think it is most important that we should have a fair amount of time for questioning; but perhaps some of the questions—as Mr. McNeill has suggested—will be answered in Mr. Cass-Beggs brief. Will you please proceed?

Mr. GODIN: Mr. Chairman, I have one question which probably will not be answered in Mr. Cass-Beggs brief. I refer to the last paragraph on page 1 where the word "fully" was skipped. Was that done purposely in Mr. McNeill's brief?

The CHAIRMAN: You refer to the last paragraph on page 1 of Mr. McNeill's brief?

Mr. MCNEILL: No. If I omitted the word "fully", it was done unintentionally.

Mr. GODIN: I see. Thank you.

The CHAIRMAN: I shall now ask Mr. Cass-Beggs to present his brief.

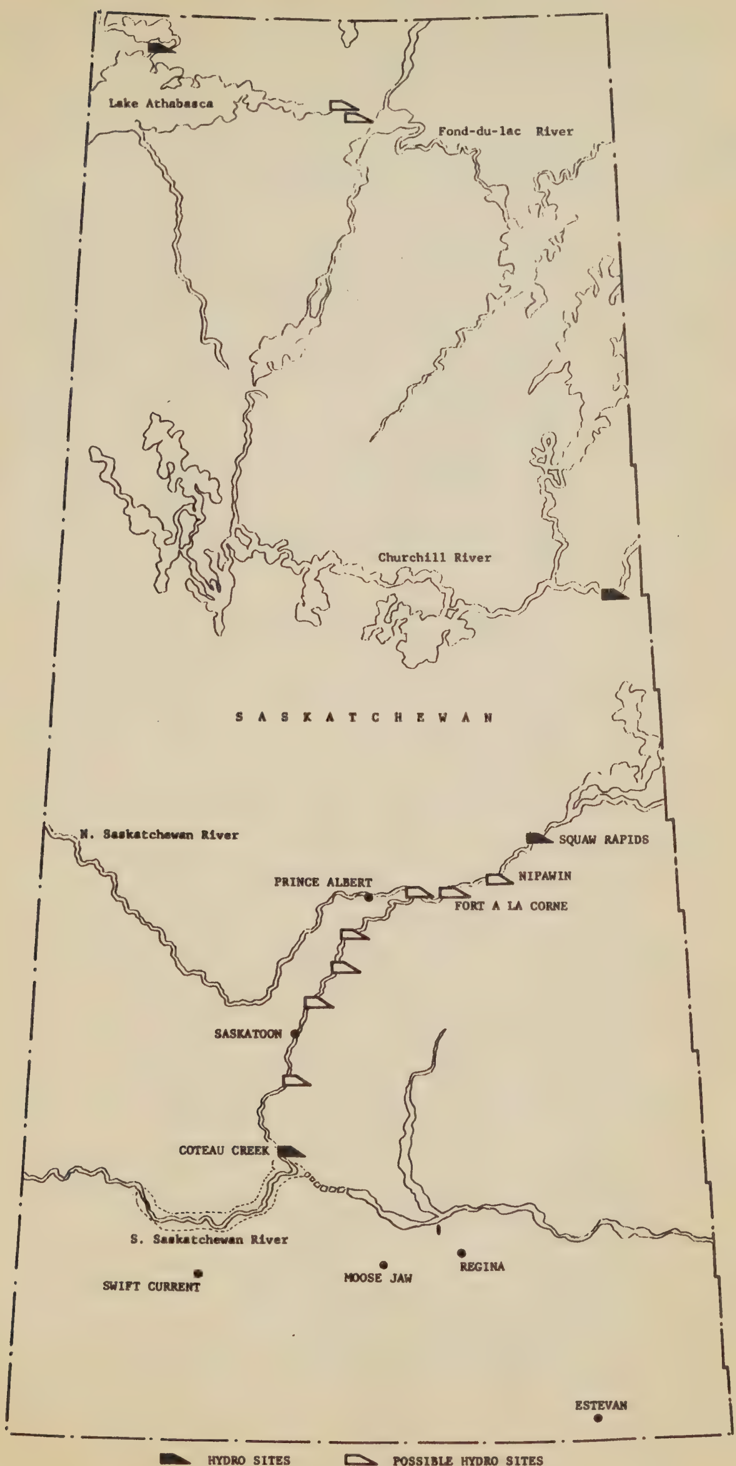
Mr. D. CASS-BEGGS (*General Manager, Saskatchewan Power Corporation, Regina, Saskatchewan*): Mr. Chairman, with your permission I shall skip sections of my brief and summarize it right from the beginning.

The CHAIRMAN: Is it the wish of the committee that the brief be printed as read and that Mr. Cass-Beggs summarize it for us now? Is that agreeable? Agreed.

The province of Saskatchewan has not hitherto been considered to be one with significant hydro resources and compared with Quebec and British Columbia this is still the case. However, the southern portion of the province,

C - 9

POTENTIAL HYDRO-ELECTRIC SITES IN SASKATCHEWAN



which contains virtually the entire population, is traversed by the Saskatchewan river and most of the population is within a hundred miles of one point or another of the river system. The south branch of the river enters the province from Alberta some one hundred and twenty miles north of the United States border and then towards the centre of the province swings north for some two hundred miles through the city of Saskatoon and joins the north branch of the river which enters near Lloydminster and traverses the province from west to east. The junction of the two branches is some thirty miles east of the city of Prince Albert, approximately central in the province, and about one hundred miles south of the precambrian shield. As the river flows east to the Manitoba border it traverses good forested and agricultural park land.

Almost throughout its length, the river has carved for itself a deep valley of varying widths. At most points, it is of the order of half to one mile in width, and the banks are frequently over two hundred feet in height. At the point at which the south branch swings north in southern Saskatchewan a deep valley similar to the Saskatchewan river valley continues on to the east, but now only contains the very small Qu'Appelle river, which entering the Assiniboine river, finally flows into the Red river in Manitoba. The Qu'Appelle valley, some two hundred and fifty miles long crossing southern Saskatchewan may be considered to have been a former course of the south branch of the river. The southern plains of the province are traversed by many coulees similar to the Qu'Appelle valley, some containing lakes, but none of them now containing the major rivers which it would appear at one time formed these significant valleys.

The divide between the southern watershed of the Missouri-Mississippi system and the northern watershed draining into lake Winnipeg is by no means pronounced, but it lies somewhere in the plains south of the city of Regina and passes through the Cypress hills in the southwest corner of the province. The general slope of the land is from the south and west to the north and east, but it is very slight as may be noted from the fall of the Saskatchewan river of the order of one foot per mile, or a total of 1,000 feet, from the Alberta border to the Cumberland lake and the muskeg areas in north-eastern Saskatchewan. In spite of the absence of mountains and waterfalls it may well be possible to develop from this river more power than from the recent St. Lawrence seaway development.

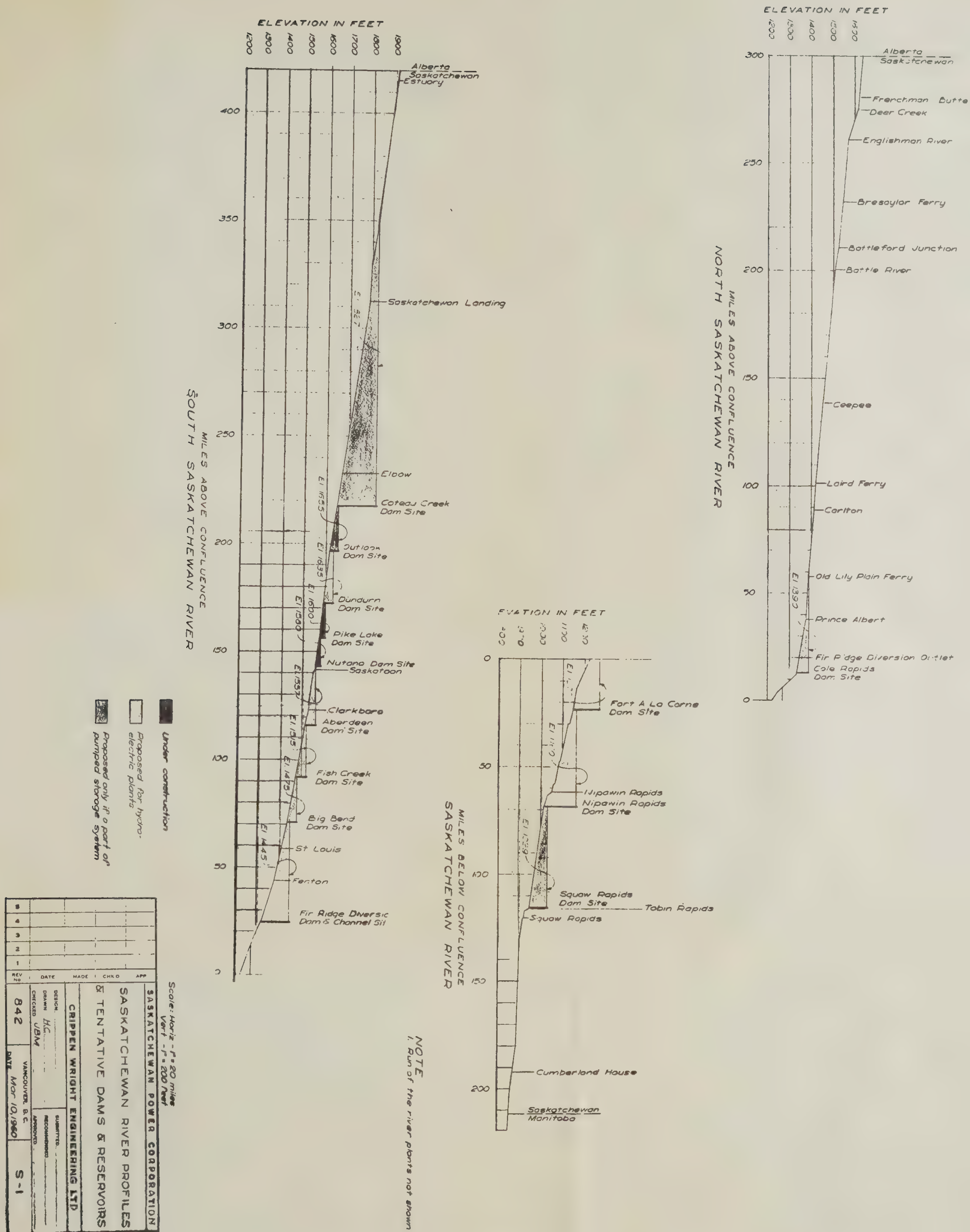
In the northern half of the province there are significant hydro resources in the Churchill river and in the Fond du Lac river with several small power sites available on other streams. Enormous areas of the northern part of the province are under water in the form of large shallow lakes and considerable storage exists which would benefit future hydro development. To date the only significant hydro development is the Island falls plant on the Churchill river near the Manitoba border, supplying power to the Hudson Bay Mining and Smelting Company at Flin Flon. This has an installed capacity of some 120,000 h.p. A small development to the north-east of lake Athabasca presently supplies part of the needs of the Uranium city area. Although the total amount of water in the Canadian shield area is large, it does not form any very significant concentrations of hydro power and development is unlikely for other than relatively local use, nevertheless industrial developments in the shield area could be reasonably well assured of adequate hydro electric resources. The most significant sites in the northern area are on the Fond du Lac river below Black lake. They may be capable of some 200,000 h.p. but are over 700 miles north of Prince Albert, and some 60 miles south of the northern border of the province.

Saskatchewan's slow history of hydro development has no doubt arisen to a considerable extent from the abundance of low cost lignite coal in the southeast of the province. The coal is capable of being mined by strip mining operations and although it is of low calorific value (some 6,500 Btu per pound) it is so relatively inexpensive that it represents probably the cheapest fuel in Canada. It can be mined and transported to an adjacent plant at a price close to ten cents per million Btu, which roughly corresponds with the cost of natural gas at the wellhead. However, this fuel is located in the extreme southeast of the province, at Estevan, is one hundred and fifty miles from Regina and cannot economically be transported by road or rail for significant distances. A total installation in two plants of some 200 megawatts (270,000 h.p.) of generating capacity utilizes this coal and provides for a major part of Saskatchewan's current power needs. The coal resources are adequate for hundreds, if not thousands of years. At Saskatoon two thermal power stations having a combined installed capacity of about 230 megawatts (300,000 h.p.), and burning Alberta coal, natural gas and oil, are so operated that they allow the maximum use to be made of the more economical lignite coal of the southeast. A high voltage transmission grid interconnects the two centres of thermal generation. Six other thermal power stations, burning natural gas, oil or coal, exist and are connected to the system.

Two hydro projects are at present under construction in Saskatchewan. A plant at Squaw rapids is located at the furthest point downstream on the Saskatchewan river at which a useful head can be developed. It lies in the northeast of the southern half of the province some thirty miles east of the town of Nipawin. It uses water of the combined north and south branches and the completion of the project in 1963 will provide a reservoir extending up to the town of Nipawin. The plant will consist of eight units with a total capacity of about 350,000 h.p. The first four units of this plant are planned to be in service in time for the winter requirements of 1963.

The south Saskatchewan project, which is a joint Federal-Provincial project for the multiple purposes of irrigation and power, is located on the south branch of the river some sixty miles south of the city of Saskatoon. It will impound the water of the south branch, forming a reservoir some one hundred and forty miles long within the valley of the river. It consists primarily of a large earth-fill dam, developing some one hundred and sixty feet of head. It is anticipated that the dam will be complete and that the reservoir will have reached minimum operating level by the fall of 1966. Work will commence on a hydro power station associated with the project in 1964, and it is anticipated that it will consist initially of three units, each of approximately 84,000 h.p. (62,500 kilowatts) at full operating head. The general construction of the project will make it possible at a later stage to add two additional units when increased capacity is required to meet peak loads. However, the energy associated with the south branch of the river would not support this magnitude of development except for the possibility of using it to provide the peak winter loads. The energy generated at the south Saskatchewan project initially is expected to exceed some 500 million kilowatt-hours per annum in an average year, but will decrease as irrigation reduces the available water. At the Squaw rapids site some 1,000 million kilowatt-hours per annum will be generated initially in an average year.

It is anticipated that the Squaw rapids development will meet the expanding power needs of the province until 1965, at which date some additional capacity will be installed at some point on the system, not yet determined, and the completion of the south Saskatchewan project in 1966 will meet the requirements for the next two years. Beyond 1968, other resources are required and are under investigation.


ELEVATION IN FEET
MILES ABOVE CONFLUENCE
SOUTH SASKATCHEWAN RIVER
Alberta
Saskatchewan
Estuary
Saskatchewan Landing
Elbow
Coteau Creek Dam Site
Outlook Dam Site
Dundurn Dam Site
Pike Lake Dam Site
Nutana Dam Site
Saskatoon
Clarkboro
Aberdeen Dam Site
Fish Creek Dam Site
Big Bend Dam Site
St Louis
Fenton
Fir Ridge Diversion Dam & Channel Sill
MILES ABOVE CONFLUENCE
NORTH SASKATCHEWAN RIVER
Frenchman Butte
Deer Creek
Englishman River
Bresaylor Ferry
Battleford Junction
Battle River
Ceepee
Laird Ferry
Carlton
Old Lily Plain Ferry
Prince Albert
Fir Ridge Diversion Outlet
Cole Rapids Dam Site
MILES BELOW CONFLUENCE
SASKATCHEWAN RIVER
Fort A La Corne Dam Site
Nipawin Rapids
Nipawin Rapids Dam Site
Squaw Rapids Dam Site
Tobin Rapids
Squaw Rapids
Cumberland House
Saskatchewan
Manitoba
Under construction
Proposed for hydro-electric plants
Proposed only if a part of pumped storage system
NOTE
1. Run of the river plants not shown
Scale: Horiz - 1" = 20 miles
Vert - 1" = 200 feet
SASKATCHEWAN POWER CORPORATION
SASKATCHEWAN RIVER PROFILES
& TENTATIVE DAMS & RESERVOIRS
CRIPPEN WRIGHT ENGINEERING LTD
VANCOUVER, B.C.
Mar 10, 1960
842
S-1

Essentially the whole of the flow of the Saskatchewan system comes from the rocky mountains. The small precipitation of the prairie regions contributes very little to the flow of the river. Consequently, the natural flow shows an extreme fluctuation, with very high flows in the early summer extending to July and extremely low flows in the winter period. There are no significant lakes in the upper waters of either branch of the river and very little storage has been developed. Up to the points at which the north and south branches cross the Saskatchewan border, the rivers are essentially unregulated. The south Saskatchewan reservoir will provide almost perfect regulation of the south branch of the river. It is indeed capable of smoothing out the annual fluctuations over a period of two to three years. Since the south branch represents roughly fifty percent of the total flow of the Saskatchewan river, this regulation has a significant effect on the flow of the combined river. If the south Saskatchewan reservoir can be so operated that most of the water is released in the winter period, when demands for power are highest, its regulating effect on the main river will be enhanced. The flow of the northern branch, being mainly in the summer, added to the water released from the reservoir on the south branch in the winter, will give a reasonably uniform flow to the main river throughout the year. Relatively small reservoirs associated with the downstream plants will serve to adapt the flows to the varying power requirements.

The long-term prospects for the development of hydro-electric power in the total Saskatchewan river system are far more favourable than has hitherto been considered. Preliminary studies undertaken by and for the Saskatchewan power corporation indicate that it would appear to be feasible to develop the whole of the head of the Saskatchewan river from the south Saskatchewan project to Squaw rapids in the north-east of the system. To do this, dams would be built at intervals throughout the length of the river; each one forming a reservoir that would extend to the foot of the next dam up-stream. Thus the whole of the river would be controlled and it would be converted into a series of lakes. The possibility of developing the whole of the head of a river of this kind opens up some very interesting possible developments and provides flexibility in the design of individual projects that is of great importance. For example, within the limits of the height of the valley walls and the amount of land that it is permissible to flood, it is possible to contemplate a system consisting either of the minimum number of the largest dams that are feasible or alternatively more projects consisting of smaller dams, thus it is possible to choose the most economical combination of the elevations of the individual projects.

While it would be decidedly premature to indicate any particular locations for the plants that are contemplated beyond the two now under construction, it is reasonably clear that starting with Squaw rapids, plants could be located on the main river near the town of Nipawin, again near the Fort a la Corne site that has been so frequently studied, and again close to the confluence of the two branches of the river. This site would include the head at La Colle falls, close to Prince Albert, which was the site of an abandoned project some forty-five years ago.

On the south branch three sites appear to be available between the confluence and Saskatoon and possibly three between Saskatoon and the south Saskatchewan project including one near Dundurn. Less attention has been given to the north branch to date, but there seems to be little doubt that significant sites could be developed on the north branch of the river. Projects would, of course, be adapted to the particular geographical conditions, but in general the dams would be earth-fill dams, much smaller than the south Saskatchewan project and the head developed at each stage would be significantly less. It is probable that development of the north Saskatchewan river would be the last phase to be undertaken.

The projects feasible in the section east of the confluence, including a plant effectively at the confluence of the two rivers (utilizing both flows) would be capable of a combined ultimate installation of some two million horsepower and might reasonably be expected to develop three to four thousand million kilowatt-hours per annum.

Between the south Saskatchewan project and the confluence of the two branches about 265 feet of head might be utilized, providing a total capacity about 1.5 times that of the Coteau Creek plant at the south Saskatchewan project. Since the latter would be about 400,000 h.p. at 5 unit development, the total installation in the south Saskatchewan river could easily be a million horsepower.

There is little reason to think that the north branch of the river could not also sustain at least 750,000 h.p. The ultimate possible installation on the Saskatchewan river system within Saskatchewan may thus reach nearly four million horsepower. This would be more than the present Canadian development at Niagara falls and more than 50% of the present hydro resources developed by the Ontario Hydro-Electric Power Commission.

It will be noted that these estimates of installed capacity and energy indicate much larger installations in relation to the flow or energy available than has been general practice to date. Most hydro systems in Canada have been developed as the sole source of energy for the area concerned, and when in recent years thermal stations have been added they were initially regarded as "firming up" the hydro supply and used on a minimum basis.

It is recognized today that where fuel is reasonably cheap and where adequate storage reservoirs exist, the most economical operation is secured by operating the thermal stations on base load (that is, essentially continuously at as near full load as possible) and operating the hydro plants to take the daily or seasonal fluctuations or peaks. While the proportion of hydro to thermal installation would be adjusted so that the whole of the available hydro energy was used, in relation to the hydro energy produced the hydro installation would be much larger than normal. The thermal plant would operate at a much higher load factor than that of the system and the hydro at a much lower load factor, but the two together would meet the system requirements.

The economic feasibility of this pattern arises out of the fact that while hydro capacity is initially more expensive than thermal, once the reservoir is provided the plant can be expanded at much lower unit costs than thermal plants. Nuclear energy as at present developed fits into the thermal classification for the above argument.

In Saskatchewan, the ratio of thermal to total installation may well be 40% over the period in which hydro resources are still available and capable of expansion. Thus at the stage at which four million horsepower of hydro was installed (three million kilowatts) there would be some two million kilowatts of thermal plants, or some five million kilowatts in total. This may be expected to occur between the years 1980 and 1990. Consequently, we can foresee a thirty year period of intensive development of hydro resources at the end of which time all the sites on the Saskatchewan river system in Saskatchewan will have been developed. Beyond this period, certain other techniques for increasing hydro capacity may well be developed on a moderate scale, but in the long run the proportion of thermal to hydro will rise.

The earlier discussion of sites and capacities were mainly from the point of view of technical feasibility. The economic aspects of these proposals have not yet been fully determined. However, none of them are on the scale of the south Saskatchewan project. The sites indicated would appear to make possible the development at roughly normal cost. The dams being much lower than the south Saskatchewan dam would cost a great deal less and since presumably all the plants on the southern branch of the river would operate

on exactly the same schedule as the main plant at the south Saskatchewan project, relatively little additional storage is needed for the operation of the plants. The area of the reservoirs provided by the downstream projects is therefore of relatively little significance, while the combined reservoir capacity provided by the proposed plants on the main river is entirely adequate. East of the confluence of the two streams, the banks are higher and the river valley is much narrower than at the south Saskatchewan project. Moreover, it would appear that generally better foundation conditions exist the further down the stream the project is located.

The cost of the Squaw rapids project is expected to be approximately $180 per horsepower for the first six units, with an incremental cost for two further units of about $85 per horsepower. It would appear that the three other plants proposed on the main section of the river would, at this date, cost no more. This price is quite favourable compared with the cost of hydro-electric developments elsewhere in Canada. There are probably no developments available in Ontario which could equal this cost at the present day, although, of course, the earlier history of Ontario plants has shown much lower costs.

The following tentative data relates to the Saskatchewan river plants below the confluence:

| Site | No. of Units | Size of Units h.p. x 1000 | Total h.p. x 1000 | Cost $ x million |
|---|---|---|---|---|
| *Squaw rapids* | | | | |
| Initial development ...... | 6 | 45 | 270 | 49 |
| Expansion .............. | 2 | 45 | 90 | 8 |
| Ultimate ............... | 8 | 45 | 360 | 57 |
| *La Corne* | | | | |
| Initial development ...... | 5 | 60 | 300 | 54 |
| Expansion .............. | 5 | 60 | 300 | 26 |
| Ultimate ............... | 10 | 60 | 600 | 80 |
| *Nipawin* | | | | |
| Initial development ...... | 5 | 60 | 300 | 54 |
| Expansion .............. | 7 | 60 | 420 | 36 |
| Ultimate ............... | 12 | 60 | 720 | 90 |
| *Forks* | | | | |
| Initial development ...... | 6 | 67 | 400 | 72 |
| Expansion .............. | 4 | 67 | 270 | 23 |
| Ultimate ............... | 10 | 67 | 670 | 95 |

The investment contemplated for four plants on the Saskatchewan river between the confluence and the Squaw rapids plant including Squaw rapids, would thus be some $229 million for an initial installation of the order of 1,270,000 horsepower, and a later investment increasing this capacity as it was required for peaking purposes to about 2,350,000 horsepower would cost a further $93 million, bringing the total up to some $322 million.

The Coteau creek plant at the south Saskatchewan project is currently estimated to cost about $57 million for the 5-unit development of some 400,000 h.p. Adding to this an estimated $85 million for the remaining plants on the south branch gives a total investment of $142 million, for a total of one million horsepower.

Assuming that by 1990 some 650,000 h.p. will have been developed on the north Saskatchewan river at a cost of $130 million ($200 per h.p.) the grand total of investment in hydro resources will have reached virtually

$600 million. In the period to 1990, the thermal capacity will have been expanded by some 1,500 megawatts at a cost of some $225 million, or a total investment of more than $800 million in generating facilities alone. These figures are based on present costs and dollar values.

By 1980 load predictions which we consider to be somewhat conservative would require an installed capacity of some 2,750 megawatts, or 3,670,000 horsepower. If 60 per cent of this were hydro, the installed capacity by 1980 would be 2,200,000 h.p., which might be obtained from the initial development of all the plants below the confluence and full development of those on the south branch, but excluding the north branch. The cost of these would be some $370 million, while increments to thermal capacity in the period (about 1000 megawatts) would cost a further $150 million, making a total of $520 million in the next twenty years.

It should be noted that all the sites on the Saskatchewan river system are at relatively satisfactory locations in relation to the provincial loads, and the existing transmission network has been developed to take them into account, but nevertheless considerable investment must be made in transmission facilities concurrently with the development of the sites.

The continuous development of fuel-burning stations as an alternative to hydro development would require lower capital investment, but the cost of the resulting energy would be higher. The provincial utility is in the difficult position of having to choose between the lower capital expenditures, which are more easily within the means of the provincial utility (with the resulting higher costs of energy) and finding some means of financing the larger and more desirable ultimate expenditure to develop the hydro-electric resources. It is for this reason that a request has been made to the federal government for a power development loan at the prevailing rate of federal government borrowing and with long repayment periods. It is usual to ascribe some thirty to thirty-five years to the life of a thermal station, while a minimum life of 50 years is taken for a hydro station. Consequently, long-term loans are particularly desirable for hydro developments, to avoid repeated re-financing during the normal life of the asset.

It was mentioned at an earlier stage that the full development of the Saskatchewan river in the form of a continuous series of lakes would offer some additional advantages. Quite apart from the enormous advantages for recreational purposes, the operation of the hydro developments under winter conditions would be greatly simplified. A thick covering of ice is formed on the river early in the winter and this normally remains throughout the winter season. Under the fully developed conditions indicated, the flow would be continuously below the surface of the ice. The intake to each plant and the discharge from it being from one lake into another under the ice cover. Ice problems so often encountered in hydro plants would be considerably reduced with this technique. The capacity of the discharge channel could be made as large as was desired and each plant could be made capable of handling very large flows over relatively short period to meet the peak requirements of the system load, while the lignite coal burning stations could meet the base load.

It is common knowledge that electricity as such cannot be stored, and it is equally obvious that the electrical loads of the system are by no means uniform, even in a highly industrial economy the daytime loads will normally be at least twice the night-time load. Consequently a plant installed to meet the daytime requirements will be idle to 50 per cent of its capacity during the night. Where suitable sites are available, it is often possible to improve the economics of generation by providing what is known as "pumped hydro storage". In its simplest form this involves the use of two reservoirs, one at a higher elevation than the other. Connecting the two reservoirs would be an

installation consisting of an electric motor driving a pump which was capable of functioning conversely as a hydraulic turbine driving a generator. During the night power generated by the steam plant using its idle capacity would be used to pump water from the lower reservoir to the upper one. During the peak loads of the daytime, water from the upper reservoir flows back through the installation generating electric power in exchange, thus effectively providing for the storage of the electricity produced at night in the form of stored water. An installation of this kind is in operation associated with he Sir Adam Beck plan at Niagara falls and several other installations are in use in different parts of the world.

The chain of lakes contemplated for the Saskatchewan river would be readily adaptable for this purpose and at such time as there was a continuous development from north to south, it would be possible to pump water up-stream and in effect reverse the flow of the river. This would lead to the result that at such times as it was economical to do so water could be moved from the north Saskatchewan river and stored in the reservoir of the south Saskatchewan river. If new sources of water could be found for the northern system, for example, by diverting water from the more northerly watersheds, it would be possible materially to increase the amount of water in the south Saskatchewan system thus permitting greater use of water for industrial, domestic, or irrigation purposes.

The water moved up-stream in this fashion would, of course, be expensive water, since it would have absorbed a great deal of energy in the course of the pumping operation. It would be capable of giving back this energy if it were passed through the turbines to generate electricity, but the ultimate value of water in southern Saskatchewan might easily support the cost of the energy used for the pumping operation, for that part of the water that was not used for power generation.

The Qu'Appelle valley stretching across the southern part of Saskatchewan from approximately the site of the south Saskatchewan project, passing some twenty miles north of Regina and ending at the Manitoba border, offers some very attractive possibilities of storage reservoirs and small hydro installations probably of a pumped storage type to meet the peak loads in the southern system. No detailed studies of these potentialities have been made, but there would appear to be little reason why the whole Qu'Appelle valley should not ultimately be converted to a continuous series of lakes separated only by the small residential areas and resorts that now exist, or that would be developed between the lakes in the continuous chain. Provision will be made in connection with the south Saskatchewan project for the release of a certain amount of water in the Qu'Appelle system. This will be done at the Qu'Appelle dam, which forms part of the south Saskatchewan project. Relatively inexpensive dams in the valley would form reservoirs leading to much better control of flood conditions, to the re-establishment of lake levels to the provision of vastly increased resort facilities, and when needed to the development of pumped storage hydro developments. Reservoirs in the Qu'Appelle valley would also provide domestic and industrial water facilities of enormous value.

The land elevations of southern Saskatchewan are so relatively low that it is not a matter of any considerable difficulty to take water from the south Saskatchewan reservoir over the divide between the northern and southern drainage areas into the Souris valley or Long creek, thus diverting water into the southern watershed and particularly into the southeastern area where the lignite coal is extremely abundant, but where the necessary supplies of water to make its use industrially attractive, are extremely scarce. Given the possibility of replenishing the Saskatchewan reservoir by water pumped in stages from the northern watershed, even from the Churchill watershed, it

should be possible to contemplate the movement of water from the north of the province into the south-east corner, thus solving the long-term problem of industrial development in this area of Saskatchewan and providing for vastly increased populations.

Saskatchewan power corporation and the Manitoba hydro-electric board will complete in the next two months a high voltage line inter-connecting their thermal stations at Brandon and Estevan. These stations are approximately 150 miles apart and represent roughly the most easterly point of the Saskatchewan system and the most westerly point of the Manitoba system. By means of this inter-connection, it will be possible for the two systems to inter-change power to secure any economies that may be available arising out of the relative costs of fuel in the two systems, and the relative availability of hydro-electric power. The basic principle accepted in an agreement between the two provinces is that the economies arising out of the inter-change of power will be computed and divided equally between the two provinces. It happens that approximately 50 per cent of the transmission system involved lies in each province and they have been individually responsible for those portions lying within each province. Savings may be expected to arise out of three main situations: First, the fact that the fuel burned in the Brandon station comes from Estevan, Saskatchewan, and by burning it in effect at Estevan and transmitting the power electrically a considerable economy can be made as a result of the high freight rates applicable to the fuel.

The second situation leading to economies arises out of the fact that the provinces are largely in different time zones and the peak loads in one province will be staggered with respect to those in the adjacent province by one hour. It is thus theoretically possible at least that the two provinces together could maintain less capacity to supply their total load than if they were separately meeting their load requirements. The third potential economy arises out of the fact that each province could help the other in the event of failure of equipment, and that as a result the combined equipment held in reserve would be less than the sum of the separate requirements. This inter-connection with Manitoba operating at 230,000 volts is of significant capacity in relation to the two systems at the present time, but cannot be considered adequate for moving large amounts of power from one province to the other. However, it represents a start on a principle which should be widely extended. A similar inter-connection between Manitoba and the western portion of the Ontario hydro system has existed for some years, and as a result the electrical systems west of the Great Lakes up to the Saskatchewan-Alberta border will shortly be operating in synchronism as a single electrical system. It is possible that a tie may be developed between Saskatchewan and Alberta along somewhat similar lines.

However, there is an extremely important argument for a major inter-connection of all the electrical systems in Canada from coast to coast. At a technical meeting of the engineering institute of Canada held in Banff in October 1959, the writer presented an economic survey of this problem and concluded that the annual savings to be secured through, first, the most economical use of the available energy resources, secondly, through the staggering of peak loads by taking advantage of the various time zones across Canada, and, thirdly, the reduction in standby equipment required for the inter-connected system would be much more than adequate to meet the costs of a trans-Canada system. It is possible to contemplate a transmission line starting in British Columbia and traversing Canada, making connection at one point in each province and terminating in Nova Scotia. The transmission line would technically represent what is known as a bus, or omnibus bar or connection, rather than a point-to-point transmission system. Since power would be fed

into the line at various points and withdrawn from it at various points, without there necessarily being an overall movement of power throughout the whole line. According to the time of the day and according to the availability of resources, power would flow in one direction or another, in one part or another of the inter-connecting line. The problem of despatching power to, or receiving power from the lines, to achieve the minimum total cost for the system could be handled by computers with the power transferred either handled automatically or by the continuous relaying of instructions to the participating systems. It would be reasonably safe to claim that there are today no insuperable technical barriers to its development. The line itself might well be a direct current transmission line, which would have the advantage of leaving the control of frequency in the hands of each individual utility and for providing perhaps greater flexibility. Each individual link in the trans-Canada system would be about 500 miles, a distance which lends itself well to the use of direct current.

With such a system in operation, power developed, for example, from the Columbia system in British Columbia could move east towards and perhaps as far as Ontario, while power developed in Quebec from hydro resources could move west to Ontario and east to Nova Scotia. Power developed from fuel resources from Alberta and Saskatchewan could supplement power from British Columbia and during peaking periods the hydro resources of Saskatchewan and Manitoba could be added to meet peaking requirements of the provinces further east. The difference of two to three hours between the Ontario and Quebec system on the one hand, and Saskatchewan, Alberta and British Columbia on the other, should make possible significant savings in installation. While the paper referred to was of a very preliminary nature, it established an a priori case for further studies of this proposal, which would lead to the better use of Canada's energy resources and to an overall reduction in cost.

> Engineering studies relating to hydroelectric development in Saskatchewan are in the hands of Crippen Wright Engineering Ltd. of Vancouver, British Columbia and use has been made of some of their findings.

Mr. CASS-BEGGS: I call your attention to the map at the beginning of my brief, and I will omit the descriptive material about the Saskatchewan river, and perhaps deal only very briefly with power sites in the northern part of the province.

As mentioned on page 3 the northern power sites are not large enough to warrant having electric power generated in the north of the province for use in the south. There is capacity available, or potential sites available for some 200,000 horsepower, but they are over 700 miles north of Prince Albert, and only some 60 miles south of the northern border of the province.

Nevertheless scattered throughout the shield area there are sites which would support hydro plants locally. But I am not considering them from the point of view of over-all development for use in the southern part of the province.

Saskatchewan's slow history of hydro development has no doubt arisen to a considerable extent from the abundance of low cost lignite coal in the southeastern part of the province. That is probably responsible for the cheapest fuel in Canada, comparable in cost with natural gas (which will be about ten cents per million BTU's) but it is in the extreme southeastern part of the province and transportation of it is expensive. The resource of lignite coal is adequate for hundreds if not thousands of years. The province's present requirements are based largely on lignite coal.

Two hydro projects are at present under construction in Saskatchewan. A plant at Squaw Rapids is located at the furthest point downstream on the

Saskatchewan river at which a useful head can be developed. It lies in the northeast of the southern half of the province some thirty miles east of the town of Nipawin. It uses water of the combined north and south branches and the completion of the project in 1963 will provide a reservoir extending up to the town of Nipawin. The plant will consist of eight units with a total capacity of about 350,000 horsepower. The first four units of this plant are planned to be in service in time for the winter requirements of 1963.

I will not describe the south Saskatchewan project other than to say that work will commence on the power plant associated with the south Saskatchewan project in 1964. It is anticipated that it will consist initially of the three units, each of approximately 84,000 horsepower at full operating head.

The general construction of the project will make it possible at a later stage to add two additional units when increased capacity is required to meet peak loads.

It is anticipated that the Squaw Rapids development will meet the expanding power needs of the province until 1965, at which date some additional capacity will be installed at some point on the system, not yet determined, and the completion of the south Saskatchewan project in 1966 will meet the requirements for the next two years. Beyond 1968, other resources are required and are under investigation.

May I draw your attention to a graph of the developing loads of the province—this is on the page following page 18—showing the present developments including the south Saskatchewan capacity. The graph has been projected to 1980. The south Saskatchewan reservoir will provide almost perfect regulation of the south branch of the river. It is indeed capable of smoothing out the annual fluctuations over a period of two to three years. Since the south branch represents roughly fifty percent of the total flow of the Saskatchewan river, this regulation has a significant effect on the flow of the combined river. If the south Saskatchewan reservoir can be so operated that most of the water is released in the winter period, when demands for power are highest, its regulating effect on the main river will be enhanced. The flow of the northern branch, being mainly in the summer, added to the water released from the reservoir on the south branch in the winter, will give a reasonably uniform flow to the main river throughout the year.

The long term prospects for the development of hydro-electric power in the total Saskatchewan river system are far more favourable than has hitherto been considered. Preliminary studies undertaken by and for the Saskatchewan power corporation indicate that it would appear to be feasible to develop the whole of the head of the Saskatchewan river from the south Saskatchewan project to Squaw Rapids in the north-east of the system. This is a total head of about 1,000 feet from the Alberta border to Squaw Rapids at Cumberland lake. To do this, dams would be built at intervals throughout the length of the river, each one forming a reservoir that would extend to the foot of the next dam upstream. Thus the whole of the river would be controlled and it would be converted into a series of lakes. The possibility of developing the whole of the head of a river of this kind opens up some very interesting possible developments and provides flexibility in the design of individual projects that is of great importance.

Following page 10 there is a profile of the river and the possible dam sites are indicated.

While it would be decidedly premature to indicate any particular locations for the plants that are contemplated beyond the two now under construction, it is reasonably clear that starting with Squaw Rapids, plants could be located on the main river near the town of Nipawin, again near the Fort a la Corne site that has been so frequently studied, and again close to the confluence of

the two branches of the river. This site would include the head at La Colle Falls, close to Prince Albert, which was the site of an abandoned project some forty-five years ago.

On the south branch three sites appear to be available between the confluence and Saskatoon and possibly three between Saskatoon and the south Saskatchewan project including one near Dundurn. Less attention has been given to the north branch to date, but there seems to be little doubt that significant sites could be developed on the north branch of the river. Projects would, of course, be adapted to the particular geographical conditions, but in general the dams would be earth-fill dams, much smaller than the south Saskatchewan project and the head developed at each stage would be significantly less. It is probable that development of the north Saskatchewan River would be the last phase to be undertaken.

The projects feasible in the section east of the confluence, including a plant effectively at the confluence of the two rivers (utilizing both flows) would be capable of a combined ultimate installation of some two million horsepower and might reasonably be expected to develop three to four thousand million kilowatt-hours per annum.

Between the south Saskatchewan project and the confluence of the two branches about 265 feet of head might be utilized, providing a total capacity about 1.5 times that of the Coteau creek plant at the south Saskatchewan project. Since the latter would be about 400,000 h.p. at 5 unit development, the total installation in the south Saskatchewan river could easily be a million horsepower.

Mr. KINDT: These are in the aggregate?

Mr. CASS-BEGGS: Yes.

There is little reason to think that the north branch of the river could not also sustain at least 750,000 h.p. The ultimate possible installation on the Saskatchewan river system within Saskatchewan may thus reach nearly four million horsepower. This would be more than the present Canadian development at Niagara Falls and more than 50 per cent of the present hydro resources developed by the Ontario Hydro-electric power commission.

It will be noted that these estimates of installed capacity and energy indicate much larger installations in relation to the flow or energy available than has been general practice to date.

It is recognized today that where fuel is reasonably cheap and where adequate storage reservoirs exist, the most economical operation is secured by operating the thermal stations on base load (that is, essentially continuously at as near full load as possible) and operating the hydro plants to take the daily or seasonal fluctuations or peaks. While the proportion of hydro to thermal installation would be adjusted so that the whole of the available hydro energy was used, in relation to the hydro energy produced the hydro installation would be much larger than normal. The thermal plant would operate at a much higher load factor than that of the system and the hydro at a much lower load factor, but the two together would meet the system requirements.

The economic feasability of this pattern arises out of the fact that while hydro capacity is initially more expensive than thermal, once the reservoir is provided the plant can be expanded at much lower unit costs than thermal plants. Nuclear energy as at present developed fits into the thermal classification for the above argument.

In Saskatchewan, the ratio of thermal to total installation may well be 40 per cent over the period in which hydro resources are still available and capable of expansion. Thus at the stage at which four million horsepower of hydro was installed (three million kilowatts) there would be some two million kilowatts of thermal plants, or some five million kilowatts in total.

the night. Where suitable sites are available, it is often possible to improve the economics of generation by providing what is known as "pumped hydro storage". In its simplest form, this involves the use of two reservoirs, one at a higher elevation than the other. Connecting the two reservoirs would be an installation consisting of an electric motor driving a pump which was capable of functioning conversely as a hydraulic turbine driving a generator. During the night power generated by the steam plant using its idle capacity would be used to pump water from the lower reservoir to the upper one. During the peak loads of the daytime, water from the upper reservoir flows back through the installation generating electric power in exchange, thus effectively providing for the storage of the electricity produced at night in the form of stored water. An installation of this kind is in operation associated with the Sir Adam Beck plant at Niagara Falls and several other installation are in use in different parts of the world.

The chain of lakes contemplated for the Saskatchewan river would be readily adaptable for this purpose and at such time as there was a continuous development from north to south, it would be possible to pump water up stream and in effect reverse the flow of the river. This would lead to the result that at such times as it was economical to do so water could be moved from the north Saskatchewan river and stored in the reservoir of the south Saskatchewan river. If new sources of water could be found for the northern system, for example, by diverting water from the more northerly watersheds, it would be possible materially to increase the amount of water in the south Saskatchewan system thus permitting greater use of water for industrial, domestic, or irrigation purposes.

The water moved up stream in this fashion would, of course, be expensive water, since it would have absorbed a great deal of energy in the course of the pumping operation.

Nevertheless, it might be economical to use it.

The Qu'Appelle valley stretching across the southern part of Saskatchewan from approximately the site of the south Saskatchewan project, passing some twenty miles north of Regina and ending at the Manitoba border, offers some very attractive possibilities of storage reservoirs and small hydro installations probably of a pumped storage type to meet the peak loads in the southern system. No detailed studies of these potentialities have been made, but there would appear to be little reason why the whole Qu'Appelle valley should not ultimately be converted to a continuous series of lakes separated only by the small residential areas and resorts that now exist, or that would be developed between the lakes in the continuous chain. Provision will be made in connection with the south Saskatchewan project for the release of a certain amount of water in the Qu'Appelle system. This will be done at the Qu'Appelle dam, which forms part of the South Saskatchewan project. Relatively inexpensive dams in the valley would form reservoirs leading to much better control of flood conditions, to the re-establishment of lake levels to the provision of vastly increased resort facilities, and when needed to the development of pumped storage hydro developments. Reservoirs in the Qu'Appelle valley would also provide domestic and industrial water facilities of enormous value.

The land elevations of southern Saskatchewan are so relatively low that it is not a matter of any considerable difficulty to take water from the South Saskatchewan reservoir over the divide between the northern and southern drainage areas into the Souris Valley or Long Creek, thus diverting water into the southern watershed and particularly into the southeastern area where the lignite coal is extremely abundant, but where the necessary supplies of water to make its use industrially attractive, are extremely scarce. Given the possibility of replenishing the Saskatchewan reservoir by water pumped in stages from the northern watershed, even from the Churchill watershed, it should

be possible to contemplate the movement of water from the north of the province into the south-east corner, thus solving the long-term problem of industrial development in this area of Saskatchewan and providing for vastly increased populations.

Saskatchewan power corporation and the Manitoba hydro-electric board will complete in the next two months a high voltage line inter-connecting their thermal stations at Brandon and Estevan. These stations are approximately 150 miles apart and represent roughly the most easterly point of the Saskatchewan system and the most westerly point of the Manitoba system. Savings may be expected to arise out of three main situations: first, the fact that the fuel burned in the Brandon station comes from Estevan, Saskatchewan, and there are some high freight rates involved in moving the fuel, with the result it would be cheaper to move the electric energy. The second situation leading to economy arises out of the fact that the provinces are largely in different time zones and the peak loads in one province will be staggered with respect to those in the adjacent province by one hour. It is thus theoretically possible at least that the two provinces together could maintain less capacity to supply their total load than if they were separately meeting their load requirements. The third potential economy arises out of the fact that each province could help the other in the event of failure of equipment, and that as a result the combined equipment held in reserve would be less than the sum of the separate requirements.

A similar interconnection between Manitoba and the western portion of the Ontario hydro system has existed for some years, and as a result the electrical systems west of the Great Lakes up to the Saskatchewan-Alberta border will shortly be operating in synchronism as a single electrical system. It is possible that a tie may be developed between Saskatchewan and Alberta along somewhat similar lines.

However, there is an extremely important argument for a major interconnection of all the electrical systems in Canada from coast to coast. At a technical meeting of the Engineering Institute of Canada held in Banff in October 1959, I presented an economic survey of this problem and concluded that the annual savings to be secured through, first, the most economical use of the available energy resources, secondly, through the staggering of peak loads by taking advantage of the various time zones across Canada, and, thirdly, the reduction in standby equipment required for the inter-connected system would be much more than adequate to meet the costs of a trans-Canada system.

I estimated savings of $450 million of capital investment, and the transmission investment cost of three hundred, in place of it; and a saving of $90 million a year operating cost, replaced by $36 million a year operating cost of a transmission line.

It is possible to contemplate a transmission line starting in British Columbia and traversing Canada, making connection at one point in each province and terminating in Nova Scotia. The transmission line would technically represent what is known as a bus, or omnibus bar or connection, rather than a point-to-point transmission system. Since power would be fed into the line at various points and withdrawn from it at various points, without there necessarily being an over-all movement of power throughout the whole line. According to the time of the day and according to the availability of resources, power would flow in one direction or another, in one part or another of the inter-connecting line. The problem of dispatching power to, or receiving power from the lines, to achieve the minimum total cost for the system could be handled by computers with the power transferred either handled automatically or by the continuous relaying of instructions to the participating systems.

It would be reasonably safe to claim that there are today no insuperable technical barriers to its development. The line itself might well be a direct current transmission line, which would have the advantage of leaving the control of frequency in the hands of each individual utility and for providing perhaps greater flexibility. Each individual link in the trans-Canada system would be about 500 miles, a distance which lends itself well to the use of direct current.

With such a system in operation, power developed, for example, from the Columbia system in British Columbia could move east towards and perhaps as far as Ontario, while power developed in Quebec from hydro resources could move west to Ontario and east to Nova Scotia. Power developed from fuel resources from Alberta and Saskatchewan could supplement power from British Columbia and during peaking periods the hydro resources of Saskatchewan and Manitoba could be added to meet peaking requirements of the provinces further east. The difference of two to three hours between the Ontario and Quebec system on the one hand, and Saskatchewan, Alberta and British Columbia on the other, should make possible significant savings in installation. While the paper referred to was of a very preliminary nature, it established an a priori case for further studies of this proposal, which would lead to the better use of Canada's energy resources and to an over-all reduction in cost.

The CHAIRMAN: Thank you very much, Mr. Cass-Beggs.

Members of the committee may ask questions at this time, and either of you gentlemen may answer their questions.

Mr. KINDT: Mr. Cass-Beggs, it occurred to me, in hearing these figures on the cost of hydroelectric development, that it would have been extremely enlightening if some similar figures for atomic energy and coal could have been compared with them. Have you readily available any estimates on these alternative sources of energy?

Mr. CASS-BEGGS: Yes. I have given these figures for hydro, in terms of horsepower. You usually think in terms of dollars per kilowatt—I will have to do the arithmetic. The hydro figures run in the general order of $180 per horsepower. A typical steam plant would be $150 per kilowatt and, therefore, three-quarters of that—$112 odd per horsepower, as compared with the hydro. Of course, this is cheaper, but then you have to pay for the coal. Atomic energy figures are difficult to quote at the present time. It must be remembered that an atomic energy plant is a steam plant with a more expensive boiler installation. At the present time, the lowest costs that are mentioned are of the order of $300 per kilowatt, or double the steam cost. That would come down to a little over $200 per horsepower. It is still more expensive than hydro. Of course, with an atomic energy plant the fuel is not free. In Saskatchewan, we have estimated the capital cost of an atomic energy plant would be double the cost of a fuel plant using Estevan lignite, and the operating cost of fuel would be essentially the same, according to the present estimates of the cost of uranium fuel, because the lignite is so extremely cheap.

Mr. KINDT: In giving these figures, have you weighed in there the fact that you can locate an atomic energy plant to overcome the distance factor?

Mr. CASS-BEGGS: This is not entirely true, in that an atomic energy plant, like any steam plant, has to have an abundant supply of cooling water. We can only place a plant somewhere on the Saskatchewan river. Therefore, it would be at one of the hydro sites. Of course, we could choose the most suitable site.

Mr. KINDT: One other thought that occurred to me, while you were discussing your brief, was the question of sedimentation which, it seems to me, with the passage of time, will become more and more a real problem with reservoirs. Was the long-term problem of sedimentation taken into consideration in arriving at estimates?

Mr. CASS-BEGGS: The South Saskatchewan reservoir would absorb essentially the whole of the sedimentation. Once the flow of the river is slowed down and controlled in a series of lakes, which represents a cross-section of very considerable size, there would be no serious sedimentation below the South Saskatchewan.

Mr. KINDT: In other words, these reservoirs will eventually become settling basins.

Mr. CASS-BEGGS: No, I think the converse. The main reservoir on the South Saskatchewan will be the settling basin, and beyond that no further sedimentation problem is envisaged. The South Saskatchewan reservoir capacity for receiving sediment is such that its life is thought to be conceivably 1,000 years—but this, of course, is a matter of engineering conjecture.

Mr. MCFARLANE: I would like to ask Mr. Cass-Beggs what consideration has been given to thermal power, in the comparison of costs. I realize this is supplementary to Mr. Kindt's question. However, supposing that we did establish thermal power stations, would we not get away from long transmission lines? Also, we could erect these plants at strategic locations in the province, and get away from these pumping storage costs you mentioned. In this way, we could establish these thermal power plants, where needed, and get away from these long transmission lines which we have across the province.

Mr. CASS-BEGGS: Yes. Certainly, if we could do so economically, we would, but the combined cost of hydro and thermal comes out to be lower. We have fuel enough in the Estevan area, in Saskatchewan, to look after the province's need for 1,000 years, but in the extreme southeast corner, it would need a bigger transmission system to distribute it to the loads than the spread out hydro sites would require. The actual cost of producing the energy, even with this cheap fuel, would, over the years, be higher than with the hydro developments. Of course, there is no thought of ever building a hydro plant unless you can show it is the cheapest alternative. No such hydro plant has ever been built —and these, we are satisfied, are, in the long run, a cheaper proposition than fuel.

Mr. KINDT: A supplementary question. On page 19, you have a graph showing the projected load growth for the province of Saskatchewan, up until the year 1980. That is for hydroelectric development. In tying that in with the different sources of energy for the development of that electricity, I notice, over in the province of Alberta, that Mr. McGregor who, I think, is head of the power commission there, estimated for the Gordon royal commission, that by 1980, 45 per cent of the electricity in Alberta would be generated by the use of coal. I suspect that Mr. McGregor, in arriving at that figure, took into consideration all the economic factors, as well as the availability of hydroelectric sites.

Mr. CASS-BEGGS: Oh, yes.

Mr. KINDT: Your thinking is not along that line; your thinking is more for hydroelectric.

Mr. CASS-BEGGS: I think my thinking is the same. I gave a figure of 40 per cent, as my estimate. I stated that throughout this period of developing hydro, we would have about 40 per cent in steam. Now, of course, this is subject to plus or minus 10 per cent; it could be 30 per cent or 50 per cent, but it is in that neighbourhood. Of course, this curve relates to the total energy, whether it is hydro or steam. This curve does not differentiate, and neither does the statement in the text. We expect that about 40 per cent would be from steam, in this development period, which will extend to 1990, shall we say. Of course, beyond that, it will move to thermal or nuclear power, or whatever new technique might develop, because hydro will be exhausted by 1990. Of course,

Alberta is a little further on in the historical process of developing hydro, and can expect to reach their saturation point of hydro sooner than us.

Mr. FLEMING (*Okanagan-Revelstoke*): In relation to this concept of trans-Canada transmission of power, are the various power authorities across Canada giving serious study to this suggestion, with an idea of practical realization of such an interchange? Is this concept sufficiently widespread yet to give any sign of bringing it into being?

Mr. CASS-BEGGS: Let me put it this way: it has aroused considerable interest. The Canadian Electrical Association, which is an organization or an association of the utilities across Canada, is taking a look at it, and I think it would be premature to say that serious study is being given to it by the individual utilities. However, there is a good deal of interest.

Mr. FLEMING (*Okanagan-Revelstoke*): The concept has aroused interest?

Mr. CASS-BEGGS: Yes.

Mr. FLEMING (*Okanagan-Revelstoke*): Over how long a period would you say thought has been given to this possibility? Is it in its very early stages of consideration?

Mr. CASS-BEGGS: This is really in its early stages. It is only during the last few years it has been realized that distances of five hundred miles and a thousand miles are entirely feasible transmission distances. Ten years ago this would have been dismissed as a technical impossibility. But now there are transmission lines across Siberia, and nine hundred miles in length, from north to south, in Sweden. These are established facts now. There is no question as to the feasibility of this kind of project.

Mr. PAYNE: Yesterday we were advised that the Soviets had made a great deal more advance in the field of long transmission lines than has been accomplished on this continent. Are we aware of the methods and processes being followed in Russia, or not?

Mr. CASS-BEGGS: Yes, generally speaking, in the technical fields Russia is quite willing to provide the information. There have been papers read before world power conferences, and so on, on their developments. In this continent we take the lead from the United States, and the distribution of resources in the United States is such that there has never arisen a need for a major transmission line. It is difficult to find a transmission line of much more than 250 miles in the United States.

Mr. PAYNE: Is that situation not changing in the States at this time?

Mr. CASS-BEGGS: It is not changing in the sense of need arising for long-distance transmission; or, at least, in the sense of thought being given to it. The same arguments that are advanced in connection with the trans-Canada scheme would apply, to a considerable extent, in the States, particularly the time-zone argument, which is very important.

The CHAIRMAN: In other words, you indicate that the transmission of energy in Canada is somewhat similar to the problem we had with our trans-continental railways?

Mr. CASS-BEGGS: Yes, similar to the gas problem, in a sense. We have no coal in central Canada, and we have used up our hydro power, essentially, and something has to be done in Ontario—either in the way of atomic energy or bringing in energy from outside. Both are in line, I would think, for the future.

The CHAIRMAN: Do you feel our hydro energy should be developed first and made full use of, before we go into the field of atomic energy?

Mr. CASS-BEGGS: It would be extremely expensive. Hydro that you would turn down, as being more expensive than atomic energy.

Mr. STEARNS: What is the installed cost of atomic energy, as compared to your $200 installed cost for hydro?

Mr. CASS-BEGGS: It is of the general order of being more expensive than hydro—perhaps $230, or in that general ratio. The figures I have heard have not been realized in practice, but estimates which have been made for Canada tend to run into the $300 order per kilowatt, compared to the ordinary steam plant that runs at $150. That is, the atomic energy plant is about twice as expensive. It contains everything the ordinary steam plant contains, plus a nuclear reactor, so it is naturally more expensive.

Mr. STEARNS: What about the transportation of fuel from one place to another? If you have coal, which is not nearby, you have to pay freight on the coal to transport it to wherever you put up your plant?

Mr. CASS-BEGGS: This transportation problem is not so significant as one might suppose. One would never move coal nowadays. You always generate the power at the source of the coal, and move it as electricity. The costs of moving electricity are not very severe. The capital investment on the transmission lines associated with the project would not be more than 10 per cent of the project.

Mr. STEARNS: And the loss?

Mr. CASS-BEGGS: The loss is never more than 10 per cent, so we can fairly well dismiss transmission.

However, there is still this problem. The days when we could put a power plant down in a city and hope to have local cooling water for it have pretty well gone. Ontario, with access to the Great Lakes, is in a fairly favourable position. But Regina, for instance, is a case where you could not expand the plant significantly from what it is at the present day because there is not sufficient cooling water. The next development to serve Regina would have to be, say, over on the Saskatchewan river, if it was to be a thermal station, or down at Estevan, where we have built a dam and have formed a reservoir ten miles long solely to obtain cooling water.

Mr. FLEMING (*Okanagan-Revelstoke*): In one of our committee meetings this session we were informed that in the United States and Russia they are now working on the development of extraordinarily large steam turbines for electricity generation on coal fields. I may be wrong, but I think it was something in the order of a single-unit turbine that would produce something like 500,000 kilowatts, and, in the case of Russia as high as 750,000, if I remember correctly.

In Canada, where there are coal fields, and particularly in Saskatchewan, let us say, where coal is readily available, has any thought been given to such a very large installation producing sufficient power at the coal site that you could transmit it economically over a long distance and in a wide area, the power having been produced in these very large installations?

Mr. CASS-BEGGS: Yes, but this would presuppose a trans-Canada interconnection. A problem with large single units is that they become as large as the whole system. If we put in a half-a-million kilowatt unit—and there is one being built in Britain at the present time—that is more than the total Saskatchewan load today; and if we break down, where are we? We have to divide our capacity up among reasonable sized units. However, if it were part of the overall system—say it would handle 5 per cent—if that dropped off it would not matter. We have to consider the Canadian system as a whole before we could go to units which are much larger than, say, two or three hundred thousand kilowatts.

Mr. SIMPSON: I suppose in order to be effective these large units on coal fields must also have access to tremendous supplies of water?

Mr. CASS-BEGGS: That is true. I think it is not too optimistic to say that in ten years there is a reasonable chance of greatly reducing the amount of water needed. I think we could get a quotation from European companies today for a unit of about 100,000 kilowatts run entirely with air cooling, and you would not need cooling water at all. It would cost about 20 per cent higher, but at the present time it would be cheaper not to buy it and locate the plant where water was available. But if water simply was not available we could do it with air cooling.

The CHAIRMAN: Is one of the problems on the thermal plant the fact that you are faced with the ever-increasing cost of materials and operation, as against a hydro plant? Once it is constructed the cost of the transportation of power is so small it has very little effect over the whole cost of the power?

Mr. CASS-BEGGS: Yes, that is certainly true. This history of thermal plants has been a continual struggle in order to get more and more automatic equipment, which has just about kept pace with the increasing wage rates, and the cost of thermal power has come down. But the nature of coal is such that the more you use the more expensive it becomes to get more of it; and there is no way of getting around that fundamental economic law. With hydro, once you have built it you know what it is going to cost you for ever.

Mr. KINDT: Is there another factor that enters into it, and that is the costs maybe are less now than they will be, say, ten, twenty or thirty years from now, and you are weighting that factor in the case of the development of a hydro plant now, in contrast to the thermal plant that might develop say twenty years from now, because your costs would be vastly different at the end of that twenty-year period, comparing the one with the other?

Mr. CASS-BEGGS: Yes, but that is not the comparison that would arise over present day hydro; it would have to be compared with present day thermal. Any trends in costs would apply fairly well to both hydro and thermal. Civil engineering works are a bigger part of a hydro project; manufactured components are the bigger part of a thermal; and there may be some divergence in the rates of costs. Roughly speaking, the factors that affect the one would affect the other. If you were considering building either a hydro or thermal plant today, at the same cost, you would be very foolish not to build the hydro one, because the longer you operate it, the relatively smaller the cost becomes. The major investment should be made sooner.

Mr. PAYNE: There is one point here—and I am not trying, in any way, to rebutt the evidence which we have heard today, but last year Dr. Convey and also Dr. Ignatieff—if you would pardon my pronunciation—testified that power from atomic energy sources would be a minimum of three times the cost of the relatively moderate production cost from normal coal thermal processes. They based their figures, as I recall it, on the British projects in Scotland and stated, certainly as far as they could see, that this cost ratio differential would exist for the forseeable future and possibly well beyond 1980, unless other developments came forward to contradict this figure. Have there been changes with regard to this, or do you disagree with these other witnesses whom we heard last year?

Mr. CASS-BEGGS: No, I do not disagree. I think I quoted a factor of that order with the capital cost of building an atomic energy plant being double that of a steam plant. In the case of Estevan, comparing uranium fuel with Saskatchewan lignite, the costs are about the same. But Saskatchewan lignite is cheaper than any other fuel. You could not burn coal in Ontario at anything like the lignite cost. The Ontario fuel price would be three or four times the Saskatchewan price. That would indicate, I think, that Ontario would probably

first reach the point at which nuclear energy would be an economic feasibility and Saskatchewan last.

Mr. SLOGAN: Mr. Chairman, I believe the cost of power which is going to be generated by the CANDU atomic energy generating station—or the cost to the consumer will be 11 mills per kilowatt hour, and that compares with 5 mills per kilowatt hour for hydro electrical power in Manitoba.

I think the general consensus is that within the next year the atomic energy power will be brought down to 7 or 8 mills, and at the time when the hydro resources are used up it should be on an economic basis.

Mr. PAYNE: What basis is there for that statement?

The CHAIRMAN: Just a minute, gentlemen, please. Let us not get into cross-questioning between members of the committee, because it makes it extremely difficult, and we could get way off the track.

Mr. STEARNS: I have one question on the south Saskatchewan dam which was mentioned during Mr. McNeill's reading of his brief. Is there enough water in the south Saskatchewan river to fill that reservoir easily from zero up to 160 feet level? Is that the top, peak height of the dam?

Mr. MCNEILL: The south Saskatchewan reservoir will contain about 8 million acre-feet of water. Approximately 2.7 million acre-feet will be live storage; the balance will be dead storage.

Mr. STEARNS: In other words, 2.7 million, you figure, is the flow of the river?

Mr. MCNEILL: The average annual flow of the river is about 7 million acre-feet. We anticipate that in an average year the reservoir will re-fill.

Mr. STEARNS: It will refill?

Mr. MCNEILL: Yes.

Mr. FLEMING (*Okanagan-Revelstoke*): Mr. McNeill, in your commission's operations I suppose one of your prime considerations is the source of pollution in the river, the control and elimination, as far as possible, of any pollution that now exists, and the elimination of the possibility of continuing pollution in the future. What steps are you taking to eliminate any present pollution; and what steps have you in mind for possible control over any possible source of pollution in the future?

Mr. MCNEILL: I am not sure I can answer that question. It is a subject we have not studied in detail as yet. As far as the south Saskatchewan reservoir itself is concerned, or the reach of the river that will contain the south Saskatchewan reservoir, there are no major sources of pollution at the present time. We have recently taken steps to authorize the commission to designate lands surrounding the south Saskatchewan reservoir as reservoir development areas. In these reservoir development areas we will zone acreage for recreation purposes, urban purposes, agricultural purposes and industrial purposes. We will also establish regulations to apply to all developments within these areas, and these will include regulations to control pollution.

The CHAIRMAN: Mr. McNeill, you have control only within that area, within the boundaries of Saskatchewan?

Mr. MCNEILL: That is true; this is to some extent an interprovincial problem. And at the moment I do not feel that the machinery for tackling the interprovincial aspects of pollution is too satisfactory.

The CHAIRMAN: Have you made any studies to indicate the possibilities of navigation on the Saskatchewan river?

Mr. McNEILL: No. I have not seen any, nor am I aware of any studies on the technical or economic feasibility of navigation on the Saskatchewan system.

I understand that many years ago a study was made of this question, which indicated that it was not, at that time at least, economically feasible to develop the river for navigation. But this is a question which I think warrants some early study.

It is generally assumed that navigation of the Saskatchewan system is not economically feasible, but I think that this assumption should be subjected to serious study at a fairly early date.

The CHAIRMAN: Undoubtedly there will be some navigation, and some use made of the South Saskatchewan reservoir, will there not?

Mr. McNEILL: It is conceivable.

Mr. PAYNE: Mr. McNeill in section 5 dealt with the need for further basic information. It is not that I wish to prolong the session at all, but I do feel that something more specific might help the committee at this time.

Would Mr. McNeill inform the committee if any basic work to secure such basic information is now being undertaken by his agency or by the province of Saskatchewan, and if so, what it is?

Mr. McNEILL: What type of information are you referring to?

Mr. PAYNE: I refer to section five of your brief entitled "The need for basic information", and where you run over quite a number of factors. I think it would help the committee if we knew what plans, if any, were afoot within the province in this connection.

Mr. McNEILL: Well, the commission itself has not gone into, nor does it propose to go into the collection of basic hydrometric or other data. I understand that at the present time stream gauging stations are operated by the water resources branch of the Department of Northern Affairs, under a co-operative cost sharing agreement with the water rights branch of our province, and in cooperation with other provinces in the basin.

As I said in my brief, we propose, during the coming year, to make a detailed study of the existing and proposed programs of the water resources branch and of other federal agencies, and of the three provinces, to collect data that is basic to the stream forecasting program, and ultimately, at the end of that study, to come forth with recommendations as to where we feel these programs should be extended. We would expect to submit such recommendations first to the water rights branch, and secondly to the prairie provinces water board.

Mr. PAYNE: You have none to make at this time?

Mr. McNEILL: No.

Mr. KINDT: I have a supplementary question: as one of the basic studies which you plan to make would be the sediment measurement stations along the south Saskatchewan reservoir—

Mr. McNEILL: Not the location of sediment measurement stations along the South Saskatchewan reservoir so much; rather where sediment measurement stations should be located in the head waters of the south and north Saskatchewan rivers, and at the junction of major tributaries, to determine the sources of sediment.

Mr. KINDT: When you go into the head waters of the south Saskatchewan, by and large it is fairly clear it comes out of the mountains. But it seems to pick up sediment; and as the south Saskatchewan reaches Medicine Hat—I am very, very familiar with the conditions of that river—it is then that you run into sedimentation.

Mr. McNeill: That is correct.

Mr. Kindt: I have one other question: you said here that stream gauging stations are a cooperative arrangement with the federal government, and it has also been said by Mr. Cass-Beggs that sedimentation in the reservoirs will take a thousand years. You also say here that you believe some arrangement could apply for sediment measurement stations; in other words, the federal government should pay half the shot for sediment measurement studies.

I agree that basic, technical information is the foundation upon which a decision can be made, and I would agree with you entirely on the obtaining of basic information, but I am wondering about the urgency of it in relation to other matters which may have to be taken into consideration.

Mr. McNeill: The urgency of sediment information? Is that your question, sir?

Mr. Kindt: That is right, or a cooperative arrangement with the federal government to provide that data.

Mr. McNeill: It is true that on the basis of very tentative information, PFRA, the agency responsible for the design of the south Saskatchewan reservoir, estimated that the average annual sediment load for the main Saskatchewan river was approximately 12,000 acre feet a year, and that approximately 50 per cent of that originated in the south branch. On the basis of these tentative figures, they estimated the useful life of the south Saskatchewan reservoir to be approximately 900 years. This is very encouraging, as far as the life of the reservoir is concerned.

The province is responsible, as I have mentioned, for planning the development of the reservoir shore line; and while it may take 900 years before the reservoir fills with sediment, inside of 20 or 30 years we could have a serious sedimentation problem at the head waters of the reservoir, at the junction of the tributaries, and at other points in the reservoir where the sediment will be initially deposited.

We are unable at the present time to prepare a safe plan for recreation development around the head waters of the reservoir, nor are we able to make a fully informed decision on the elevation of the deck of the Saskatchewan Landing Bridge. First we require a study of the location of, and the rate of growth of these deltas in the head waters, and the distribution of sediment generally throughout the reservoir.

We have contacted several consultants and they have informed us that techniques are available to make this kind of study; but the usefulness of these techniques depends upon adequate information on sediment load and on stream flow. The longer your period of records, the more valid your results.

So it is a most important and urgent problem.

Mr. Payne: Before you call for adjournment, Mr. Chairman, I would like to say that I think this matter is of some importance to this overall project. I refer to pay 13 where Mr. McNeill stated as follows:

> "A less immediate but equally important question is how to operate the reservoir in order to achieve the maximum utilization of reservoir storage and river flows."

He pointed out later that development is going forward. I wish to get on the record, so that we may have something of substance here, the studies which are being made on the principal reaches of both the tributaries as well as the main stream. Have you insufficient flow studies and other technical data to make proper use of the reservoir when it is filled? If not, is the point in question—and maybe to assist you, I might say that I am sure the committee is anxious to know, although you have studies going forward which next year

could have a great deal to do with the type of report we may bring in and the recommendations which we might submit.

Mr. McNEILL: Well, we do have sufficient information at the present time to undertake plans for reservoir operation based on the 47 year period of recorded flows on the river. However, we cannot base our future operation plans entirely on the record of the past 47 years. That would assume a great deal of hindsight.

When the reservoir is completed, its successful operation will depend, very largely, on our ability to forecast flows, particularly, the spring and summer flows. I do not think that there are sufficient stream gauging and meteorological stations in the head waters to form the basis of a good basic forecasting program. As I say, this is a question that is going to be studied within the next year.

I believe you were informed at an earlier meeting that the U.S. Corps of Engineers and the United States Weather bureau made a study of the costs and benefits of a basic forecasting program for some of their major systems. They came up with a benefit to cost ratio of something like 30 to 1. If we undertook a similar study, limited to the south Saskatchewan reservoir, I am sure that we would not come up with a benefit to cost ratio of 30 to 1; however, in the future—in the next 20 years—when a larger number of hydro and multiple purpose reservoirs have been constructed, the benefit to cost ratio may reach 30 to 1, or even exceed it.

Mr. PAYNE: In other words, do you consider there is an urgency, in the next five years, for more extensive studies on the Bow river, Red Deer river, and the Old Man, which constitute the South Saskatchewan?

Mr. McNEILL: Yes. As I have stated, we will be in a position to be more concrete in a year's time.

The CHAIRMAN: I think Mr. Côté might say something on this subject, if it is the wish of the members.

Mr. E. A. CÔTÉ (*Assistant Deputy Minister Department of Northern Affairs and National Resources*): The water resources branch has something of the order of 1,200 water gauging stations throughout Canada. In connection with the South Saskatchewan river, and its tributaries, I should guess that there is something of the order of 100 metering stations.

The water resources branch considers that the ratio that now exists is something of the order of 1,200 in Canada, and about 12,000 in the United States. For the water resources we have in Canada, there is an insufficient number of water gauging stations. We are trying to increase that as quickly as funds and personnel are available—and, sometimes, it is personnel that is not always available. We are doing this, in so far as the resources of water which are exclusively within the various provinces. So, interprovincially, we are doing this in cooperation with the various provinces. So much for the water gauging stations.

We believe that there is a greater need for snow surveys, and this we propose to increase as soon as resources are available.

Also, we believe that there should be more work on the meteorological stations. An experiment is being carried out in the headwaters of the Saskatchewan, in the eastern Rockies forestry. This is being worked out with the meteorological services.

In regard to sedimentation, the water resources branch has advocated, for several years, the need for sedimentation surveys. The advisory committee on water use policy recommended this some years ago, and just last year this government decided that it would be feasible to find funds for the establishment of a sedimentation survey within the water resources branch. In this year's estimates, three persons have been established to start sedimentation

surveys, which will take place primarily in the west. We hope, in the coming year, 1961-62—although we have not worked out the estimates of personnel requirements—we will have a few more persons on that. As soon as we can get the qualified individuals—and there is a bottleneck at the moment; the positions became available last month—we will start. However, we must find the qualified individuals to do this work. As soon as we have them, we shall start establishing sedimentation surveys as quickly as we possibly can, and do as great a number as possible. This problem is one where we, in Canada, have been late in getting any work done. The P.F.R.A. started a couple of stations ten years ago. However, there has been no systematic working in that direction over the years, and we are late. We shall have to ascertain not only the amount of sediment carried in the streams, but also study ways and means of solving these problems which may cause reservoirs to become completely useless, as time goes on—and sometimes, as indicated by Mr. McNeill, it has been a good deal sooner than we have thought.

The CHAIRMAN: Thank you, Mr. Côté.

Gentlemen, it is now 11.30. As the house will be sitting next Monday morning, our next meeting will be held at 9.30, instead of 11 o'clock.

We will have General McNaughton with us next Monday, and he will discuss the work of the international joint commission.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 16



TUESDAY, JUNE 7, 1960

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

WITNESS:

Mr. E. A. Côté, Assistant Deputy Minister, Department of Northern Affairs and National Resources.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23272-8—1

STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.
and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, June 7, 1960.
(17)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Vice-Chairman, Mr. Erik Nielsen, presided.

*Members present:* Messrs. Aiken, Doucett, Fleming (*Okanagan-Revelstoke*), Granger, Hicks, Kindt, Martel, McFarlane, Nielsen, Rompré, Simpson, Slogan, and Stearns. (13)

*In attendance: From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; and J. D. McLeod, Chief Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Vice-Chairman welcomed Mr. N. W. Ahmad, Deputy Conservator in Pakistan, who is visiting Canada under the auspices of the Colombo Plan to study watershed management.

Mr. E. A. Côté, Assistant Deputy Minister, was called and he read a prepared statement on the activities of the federal government in connection with water problems and indicated how they mesh in with the activities of provinces and municipalities, and was questioned thereon. Copies of this statement were distributed to the members of the Committee.

At 11.00 a.m. the Committee adjourned until 9.30 a.m. Monday, June 13.

M. Slack,
*Clerk of the Committee.*



23272-8—2

## EVIDENCE

TUESDAY, June 7, 1960.

The VICE-CHAIRMAN: We have a quorum, gentlemen.

Before commencing with today's proceedings I would like to introduce to the committee Mr. N. W. Ahmad, deputy conservator in Pakistan. Mr. Ahmad intends to spend about six months in Canada studying the experience we have had with watershed management. He will be visiting Ontario, the prairie provinces and British Columbia. He is here under the auspices of the Colombo Plan. We are most happy to have you with us and hope that you will have an interesting as well as a useful stay in Canada.

Mr. Côté the assistant deputy minister of the Department of Northern Affairs and National Resources is here to give evidence this morning. I will ask him to commence our proceedings today.

Mr. E. A. CÔTÉ (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): Mr. Chairman, as you requested I have had prepared mimeographed copies of my presentation. I am having them distributed to the committee so that this presentation may be followed more readily.

Previous witnesses have referred to the vital role of water in Canada's economy and its increasing importance in the future. I will attempt, today, to bring into focus the main activities of the federal government in connection with water problems and to indicate how these mesh in with the activities of provinces and municipalities.

Several witnesses explained the activities of provinces and federal agencies as regards the use of waters within provincial boundaries. Commissions to conserve water, water rights branches and provincial commissions to prevent pollution of water are examples of provincial bodies to regulate the use of water in the various provinces. In Quebec, the civil code contains provisions to indicate the use that might be made of streams. In other provinces, reliance is placed on the common law and statutes to regulate the use of water.

So far as the federal government is concerned, it has some clear legislative authority over matters which—at the very least—are based in or on water. For example, the federal government has legislative jurisdiction conferred by the British North America Act over fisheries and navigation. Hence the federal government has legislated to promote the welfare of fisheries and to facilitate navigation or to regulate the activities of vessels in Canadian waters.

Parliament has concurrent legislative authority with the provinces in agriculture. As a result of severe droughts in the Prairies in the '30s, the Prairie Farm Rehabilitation Act was passed. This Act has contributed very materially in the improvement of western agriculture by the provision of water in ponds and reservoirs and in regulating streams. Likewise, the Maritime Marshland Rehabilitation Act has helped reclaim valued agriculture marshlands from excessively wet lands.

Canada has also legislative authority over birds which migrate between Canada and the United States. This parliamentary authority rests in part on the migratory birds convention of 1916 and the act passed by parliament shortly thereafter. One regulation made under this Act is designed to ensure that waters are not made harmful to the migratory birds in question. In addition, Canada concluded the boundary waters treaty of 1909 with the United States. This treaty and the legislation approving it have spelled out



23272-8—2½

some responsibilities of the federal government in relation to "boundary waters" (i.e. waters along which the international boundary runs) and also regarding waters which cross this boundary. As regards "boundary waters", Canada and the U.S.A. have equal and similar rights. The flow or level of these waters cannot be affected without the agreement of both countries or the international joint commission. Likewise, a downstream country may not back water into the upstream country without the agreement of the latter. Neither country may pollute boundary waters to the injury of health or property in the other country. Furthermore, the international joint commission set up by this treaty is bound to study problems which both governments may refer to them.

These are known as "references" to the international joint commission. This means, Mr. Chairman, that the federal government has definite responsibilities to discharge pursuant to these international obligations. Neither Canada nor the United States of America could stand idly by if the waters covered by the treaty were to be used in a manner contrary to the covenants entered into.

In an area that touches upon international relations, parliament also enacted in 1955 the International River Improvements Act, which provides that federal authorization must be obtained before any works are constructed in Canada on a river crossing into the United States which will have anything but a minimal effect on the flows.

To summarize, it might be said that, apart altogether from the provincial legislative authority over waters within a province, the federal government has in the provinces some authority over some uses of water arising out of the federal legislative jurisdiction in and over such subjects as agriculture, fisheries, navigation, migratory waterfowl and the conduct of international affairs.

In so far as the Yukon and Northwest Territories are concerned, the federal government has the responsibility for the development and use of resources (including the waters) in these areas. In the Territories (and in the National Parks) the Dominion Water Power Act is applicable. This is the successor of the Act which was in force in the prairie provinces before 1930 when the administration of the resources was transferred to these provinces.

So far as the mapping of Canada's water resources is concerned by hydrometric means, the former department of the interior started the hydrometric service on federal lands (i.e. the prairie provinces) in 1894. By now, the water resources branch co-ordinates—on a national level and in co-operation with the provinces—the measurement of most streams of national and international importance.

*Federal machinery to discharge federal responsibilities*

As regards Canada's responsibilities under the boundary waters treaty, the water resources branch of the Department of Northern Affairs and National Resources is the prime *technical* adviser to the Department of External Affairs on international water problems. The Canadian section of the international joint commission reports to parliament through the Secretary of State for External Affairs. Various members of the Branch either participate as members or head of one of the 25 or so international boards of control under the international joint commission. In addition, the hydraulic studies required by the Canadian section of the international joint commission are generally carried out by the water resources branch.

To discharge its duties effectively, the Water Resources Branch has a total of 248 persons. This staff carries out a large number of water measurements by means of about 1,200 gauges throughout the country; it conducts complex hydraulic studies in relation to the discharges of such bodies of water as the

Great Lakes-St. Lawrence system, the Columbia River, the Yukon and MacKenzie systems. The Branch carries out a very limited number of snow surveys and is about to embark upon work in the field of sedimentation surveys. As an administrator, I am continually amazed by the vast extent of the knowledge, the progressiveness and *expertise* of the Water Resources Branch engineers and staff. I am also astounded at the very large degree of federal-provincial co-operation between water resource officials of the eleven governments in all matters related to the systematic collection of water resource data.

I do not feel competent, Mr. Chairman, to speak for the work which is being carried out in other departments, such as in Mines and Technical Surveys, on the subject of ground-water surveys and hydrometric surveys on the Great Lakes; by the Prairie Farm Rehabilitation Administration for the improvement of agriculture by water impoundments; in the Department of Public Works regarding rivers and harbours improvements and the Navigable Waters Protection Act; or in the Departments of Fisheries or Transport. However, I will later describe briefly how their activities and those of other federal agencies are co-ordinated at the federal level through the Advisory Committee on Water Use Policy.

*Interprovincial co-operation—some examples*

In the field of interprovincial co-operation, you have heard mentioned by other witnesses the work of the Prairie Provinces Water Board. This Board was established in 1948 and consists of two members appointed by Canada (one from the Prairie Farm Rehabilitation Administration, and one from the Water Resources Branch) and one from each of the three prairie provinces.

The Board's function is to recommend the best use to be made of interprovincial waters in relation to the resources of the prairie provinces and to recommend the allocation of water between them. The Board's duties are:

> to collate and analyze the data now available relating to the water and associated resources of interprovincial streams; to determine what other data are required; to recommend the allocation of the waters of any interprovincial stream; and to report on any questions relating to specific projects for the utilization or control of common river or lake systems at the request of one or more of the Ministers or authorities charged with the administration of such river or lake systems.

Since its formation in 1948, the Board recommended allocations of water in 1949, 1950 and 1953. These allocations totalling about three million acre-feet annually, have all been approved by the four governments in question. The Board also made a reservation of one million acre-feet annually for small water projects.

This reservation, I may interject, is not a true allocation. It is merely sort of a "stop order", if I may use those words, to ensure there will be one million acre-feet for small water projects until the subject has been more fully explored, and a proper recommendation for an allocation is made to the four governments.

On December 3, 1959, the Board agreed to prepare a report which would

(*a*) outline a study of the physical aspects of an integrated plan for the Nelson-Saskatchewan system;

(*b*) indicate portions of the study which exists;

(*c*) summarize gaps in data;

(*d*) estimate the scope, requirements and conduct of studies for such a plan.

The Prairie Provinces Water Board will meet on July 5 to consider a preliminary report of its Engineering Secretary on this subject. It is to be expected that recommendations may be made to the four governments this year on the scope, size, duration and cost of such a study.

Apart from this interprovincial board, a number of other boards have been created from time to time either on the initiative of a province or of the federal government. Examples of such federal-provincial boards are: the Fraser River Board, as reconstituted in 1959—and, I should add, its predecessor boards as well; the Lakes Winnipeg and Manitoba Board (1956-1958) and the St. John River Board (1958-1960).

Another federal-provincial activity is set out in the Eastern Rocky Mountain Forest Conservation Act of 1947. This Act approves an agreement between Canada and Alberta to develop and protect the watersheds of rivers which irrigate or, rather drain, Alberta, Saskatchewan and Manitoba. Briefly, Alberta agreed to carry out forest management policies for a period of 25 years in the Eastern Rockies area. The federal government, for its part, contributed $6.3 million of capital aid. The Board (initially under the chairmanship of General Howard Kennedy) sets forth policies and programmes which are carried out by Alberta. Excluding the capital costs and interest thereon, the revenues from that area are such today that they exceed the administrative expenditures involved in carrying out the water and forest conservation measures annually.

*The Advisory Committee on Water Use Policy*

I should now like to discuss briefly the work of the Advisory Committee on Water Use Policy. This is a committee of federal officials established in 1955 by the federal government to advise the Minister of Northern Affairs and National Resources in the formulation of federal policies regarding water uses. This committee succeeded an earlier *ad hoc* interdepartmental committee established to consider in 1951 application by the United States to the International Joint Commission concerning the Libby Dam.

Because of the federal, provincial and international interests, it was important that there should be a consistent federal policy as regards water development in the various basins. To assist in the formulation of a consistent policy, the Advisory Committee brings together the various Canadian agencies primarily concerned. The Deputy Minister of Northern Affairs and National Resources is Chairman of the Committee. The other members are: The Deputy Ministers of Agriculture, Finance, Fisheries, Mines and Technical Surveys, Trade and Commerce, the Under-Secretary of State for External Affairs and the Secretary to the Cabinet. Other persons (such as the Chairman of the Canadian Section of the International Joint Commission) as from time to time are required in any particular case are asked to attend. In the later part of 1956, a Secretariat was established within the Department to assist the Advisory Committee on Water Use Policy in its work. At present, it consists of two officers, and is headed by Mr. K. Kristjanson.

Matters relating to the river basins of the St. John, the Souris and the Columbia were in 1955 among the most pressing water problems of general concern. I may say that these questions were matters that were before the International Joint Commission at that time. Other matters which continue to be of concern are those relating to the river basins of almost all of Canada, including the Northwest Territories and the Yukon where the federal government has more direct responsibility. It is worth noting, as a generalization, that the large majority of interprovincial and international water problems east of the Ontario-Manitoba boundary arise out of waters along which the provincial or international boundaries run, and the majority of like problems west of Ontario arise out of waters which cross provincial and international boundaries.

In 1955 one meeting of the advisory committee on water use policy was held. The items considered included water pollution, the Waterton Belly River Reference to the International Joint Commission, the possible federal participa-

tion in water power development in Canada and the situation regarding the Columbia River. In 1956 there were eight meetings held. Such matters as the Chicago Diversion, the Columbia River Problem and water pollution were examined in greater detail. While the Columbia River and its various aspects was the main item considered, other items included the Passamaquoddy Tidal Power Reference, the benefit-cost studies of the Red River basin flood control programme, pollution on the Ottawa River, Yukon River power proposals, sedimentation surveys and the Souris River Reference. In 1957 there were ten meetings held. Again most of the emphasis was on such problems as the Columbia River reference, the Chicago Diversion, Richelieu River-Lake Champlain waterway proposal and ground-water surveys. A comprehensive paper was prepared on the various rivers crossing the international boundary. In 1958 there were three meetings held to consider the Columbia River Problem, the Fraser River Board Report and the St. Lawrence River Regulation, as well as the St. John River Reference, to the International Joint Commission. In 1959 there were seven meetings held to consider the Richelieu River-Lake Champlain Waterway, the Fraser River Board Report, preparations for possible international negotiations on the Columbia, Chicago Diversion and the Passamaquoddy reference. In 1960 two meetings have been held thus far to consider the matters coming before the British Columbia-Canada Policy Liaison Committee, federal policy on water pollution and the Passamaquoddy tidal project.

As you can see from this brief outline, much of the Advisory Committee's time has been taken up by international water problems. However, domestic water policies have also received a good deal of attention. By reference to one or two examples, I might indicate in a general way the kind of issues which are considered by the Committee and what recommendations are made.

In the case of ground-water surveys for example, a sub-committee was established to assess the need for ground-water studies in different parts of Canada. The report of this sub-committee was considered by the Advisory Committee and a recommendation made to the government on the type of ground-water investigations considered essential.

There is at present a sub-committee working on benefit-cost analysis methods. Within a short time, this group is expected to present a report, which will consider general principles and procedures for use in the economic analysis of water resource projects in Canada.

In many cases, the work of the Advisory Committee does not result in any specific recommendation to the government, but the meetings result in a co-ordination of the federal position in the field of water resource development. One benefit which should not be under-estimated is derived from the exchange of information between departments and officials which such a Committee inevitably generates.

With respect to the matters coming before the International Joint Commission, Counsel for Canada, who is a member of the Department of External Affairs, and the Chairman of the Canadian Section of the International Joint Commission have an opportunity to consider the views of members of the various federal departments.

The Secretariat's main function is to provide liaison and co-ordination of the work of the various departments for the benefit of the Advisory Committee on Water Use Policy. However, there are many problems which do not fall specifically within the sphere of any one department. In these cases, the Secretariat may work with two or three departments in the preparation of papers needed by the Committee. In other cases the Secretariat will prepare papers for the benefit of the Committee or the Minister of Northern Affairs and National Resources. The Secretariat also works with the technical officers of the Water Resources Branch in the preparation of economic

data on the Columbia and other rivers. In addition we have found it convenient to ask the secretary to serve on the British Columbia-Canada Policy Liaison Committee.

*Water and other valuable resources*

The relationship of water to other renewable resources is complex. Members of the Committee will remember that in February 1958, the Prime Minister issued a call for the holding of a National Conservation Conference. Representatives of the ten provinces met late in 1958 and again in 1959 to set the framework for this conference. It is to be held in October 1961 and will deal with renewable resources only. A Conference Secretariat, led by Dr. B. H. Kristjanson, was established during the autumn and early winter of 1959. After consulting provincial and federal ministers, as well as representatives of national advisory groups, the Secretariat is preparing a programme of studies in each of the various fields, such as agriculture, forestry, water resources, fisheries, recreation, wildlife, etc. These studies will be published several months before the Conference. Parliamentarians, officials, industrialists, members of university staffs and of national organizations will then be brought together to consider these subjects in various working groups. The aim of the Conference is to throw some light on the resource problems of the nation as seen from every important aspect.

As to the emerging water problems in Canada, they are numerous—as all members realize—and will require the most careful attention and closest cooperation between the authorities responsible for the management of these resources. The proper, economic and integrated use of Canada's water resources is an important question that will undoubtedly become of increasing concern in the years ahead. Looking at the water resource itself and in its regional connotations, the major problems facing Canadians might be listed as follows:

(1) Water pollution;
(2) The regulation and use of the Fraser-Columbia River systems;
(3) The development and integrated use of the Saskatchewan-Nelson system;
(4) The hydraulic studies and use of the Great Lakes-St. Lawrence system;
(5) The development of the St. John and of the Hamilton River systems;
(6) The interconnection of the product of the water powers of Canada with other sources of energy.

---

Mr. Chairman, this presentation may have been overlong. It was, however, an attempt to give an idea how the various federal agencies cooperate among themselves and with the provinces in an effort to achieve through the federal government both domestically and internationally a coherent policy—so far as such policy lay in federal hands—as regards the most advantageous use of Canada's resources of fresh-water.

The VICE-CHAIRMAN: Thank you, Mr. Côté.

Mr. KINDT: Mr. Chairman, first of all I want to thank you Mr. Côté for an extremely valuable summarization of the various functions of boards, committees and governments that are concerned with looking over the water resources problem. To my knowledge, this is the first time that it has been set out so that you can get your teeth into it.

I would like to turn to page 7 of the presentation. You have listed there the major problems facing Canadians. Are they in order of importance, or is it simply a chronological list?

Mr. Côté: It is not so much a chronological list, Dr. Kindt, as, a geographical list going from west to east, apart from the first and the last items in the case. But the first and last problems (water pollution and the interconnection of the product of the water powers of Canada with other sources of energy) are the two large problems. Of those two problems, I should think water pollution, over-all for the whole nation, is probably the dominant one.

Mr. Kindt: I also have a question on page 6. I understand that you have a sub-committee working on benefit-cost analysis methods of the various watersheds.

I was wondering if that committee, in setting-up procedures, has decided on a definite interest rate. I ask that question because the key to the analysis of the benefit-cost ratio on a watershed is pretty much contingent upon the interest rate that is decided upon.

It was my privilege to work for three or four years on this type of work, and after having made the analysis and reduced it to a cost-benefit ratio, you could change that ratio substantially by simply changing the interest rate.

Mr. Côté: That is quite so; the interest rate is the key factor in a benefit-cost analysis. I do not know that the sub-committee is working on one interest rate. I think that they are looking more for methods of evaluating the various resources that are involved in a benefit-cost analysis.

You have tangible and intangible aspects of a benefit-cost ratio, and a lot of the intangibles might well be reduced to some greater definiteness than has existed in the past. I have in mind, more particularly, recreational benefits and areas that are ameliorated by water improvements.

Not only that; but there are also some benefits accruing from appreciated land values. I do not think that the sub-committee will come out with a definite interest rate as such, because in the final analysis, when governments have to deal with this particular subject, they must deal with the subject at a point in time and space. It is when the proposal is made to the government that has to deal with it, that the government must then look at the existing rates of interest to determine whether or not the benefit-cost ratio of such a project may come to unity.

Then there are other considerations, intangibles, such as the value of the life of the people in the community. You cannot value that; it is quite intangible. The benefit-cost ratio may not, even for a project at a given moment in time and space, come to unity; that is to say, the costs may well exceed the benefits. At a given moment there are questions of policy which may well supercede any of the economic considerations in a benefit-cost ratio.

Mr. Kindt: In other words, the intangible benefits might tip the balance?

Mr. Côté: Or, indeed, at a given moment a government may decide that for other than economic reasons—the employment situation, or otherwise—a certain project should be undertaken now, even if it is more costly on a benefit-cost ratio basis (when the capital costs may be written off) because the benefits over 50 years may be so great to a community that the project should be undertaken at that time.

Mr. Kindt: That is why I bring up the question of interest rates. It is so vital with the time period that you use. For example, take a dollar: fifty years from now, discounted at the present rate—to find the cost-benefit ratio—it would not give you very much, if you assumed an interest rate of, say, 6 per cent. On the other hand, if you assumed 2 per cent, you would still have a considerable sum left. So on all this work, in arriving at a method of coming out with a cost-benefit ratio, these things that are back of your methods of computation are so vitally important that, unless you examine them, you do not know anything about the study when you have finished.

Mr. Côté: That is right.

Mr. Kindt: You may, if you started out with the intention of having a particular project, come out with a particular benefit-cost ratio. You could do it. I am sure I could, if I chose the right technique, the right interest rates and benefits, and probably pumped up the benefits a little bit.

So there is a lot to be said in favour of this very thing you are drawing out here, of a method to which the public policy can tie, with respect to the cost-benefit ratio of watersheds.

Before leaving the subject, Mr. Chairman, I have one other question. On page 3 you have stated that in the field of interprovincial cooperation there is the work of the prairie provinces water board. Take a river like the South Saskatchewan, which crosses the three provinces on its way to the Hudson Bay. Supposing Alberta decided to utilize a large share of that water for industrial development in southwestern Alberta by putting in structures, damming waters and regulating the flow and behaviour of the streams, and had a development there in the way of a steel industry and other industries which demanded a tremendous use of water, and probably had an economic justification in other ways, such as being adjacent to raw material supplies. What would be the thinking of Saskatchewan and Manitoba on this board, if Alberta went ahead with that?

Mr. Côté: I think the first thing that would happen there would be that the provinces of Saskatchewan or Manitoba would raise the issue in the prairie provinces water board and ask that the matter be examined and that an allocation be agreed upon—and allocation of the water for consumptive purposes —as this would be withdrawing water from the system.

The Vice-Chairman: Dr. Kindt, are you finished?

Mr. Kindt: Yes, Mr. Chairman.

The Vice-Chairman: Dr. Slogan.

Mr. Slogan: Mr. Chairman, I would like to add my compliments to Mr. Côté for bringing in this brief, which covers many points of policy that we have been wondering about. There are two lines of questioning that I want to follow. The first one is this. We can see from the brief that responsibility for the development of water resources is scattered through many departments—Mines and Technical Surveys, External Affairs, Agriculture, Northern Affairs and National Resources—and it seems to me that this leads to a great deal of confusion. I have had a couple of experiences where one department did not know what the other one was doing; and I can see from the various committees that are being set up that there is an attempt at some coordination in this matter.

However, Mr. Côté, do you not think that the matter of water resources, river basin development, irrigation and flood control, is so important to our national economy and national development that perhaps at this stage of the game a separate department of government should be set up to coordinate all these different branches of activity under one central authority?

Mr. Côté: I think, Mr. Chairman, that so far as was possible at the time the Department of Northern Affairs and National Resources Act was passed, provision was made for that very thing. The act was passed in 1953, and section 5 of the act defines the duties, powers and functions of the minister.

The act says—and I will quote it if I may:

> The duties, powers and functions of the minister extend to and include all matters over which the parliament of Canada has jurisdiction, not by law assigned to any other department, branch or agency of the government of Canada, relating to:

And here you have, under heading (c):

> the forest and water resources of Canada.

So the Department of Northern Affairs and National Resources is the department that has the responsibility in this field, so far as it is not by law assigned to any other department.

Mr. SLOGAN: Is that not the big bugbear, that there seems to be so much assigned to other departments? Last year, when we made a study of the forest resources, we came to the conclusion—and it has been carried out—that it warranted the setting up of a new department.

Do you not think that the water resources of this country are every bit as vital to our national economy and are as important as the forest resources of this country?

Mr. CÔTÉ: I think that the water resources are one of the major assets of this nation, just as the forestry resources are. Whether all the water resources of Canada, so far as parliament has jurisdiction, should be handled in one department is a moot point. There are matters, for example, in the case of international relations, where the conduct of international relations may well require the discussion of these matters to be under the Department of External Affairs. International negotiations are carried on in that manner.

Mr. SLOGAN: In the Department of Trade and Commerce we have our trade commissioners, and so forth, who carry on a great deal of work in external relations. Could not, under a water resources department, this department be given responsibility for carrying on such international negotiations as may be necessary to the development of water resources in both countries?

Mr. CÔTÉ: Mr. Chairman, if you had a special department, a domestic department to deal with water resources both domestically and internationally—you would then tend to have a fragmentation of your international policy.

I am not sure myself that there is need, so far as the international aspect of water is concerned, for a separate department which would get into the field of international relations. I think there are positive dangers in going that way.

What we have at the present moment is technical advice on these matters being given by the Department of National Resources to the Department of External Affairs. There is the closest liaison, and that closest liaison has existed over the years. This may not be a good example, but it does underline some of the problems.

Mr. SLOGAN: Take the Department of Agriculture and the Department of Mines and Technical Surveys and so on. I think that Mines and Technical Surveys should do the mapping, but that the coordination of the material they produce should be done in the water resources department.

Mr. CÔTÉ: If you wish to take one specific case—and I take it that is what you are looking for—I would cite the hydrometric work on the Great Lakes that is being carried out by Mines and Technical Surveys. There is no real reason why it should not be done by the Department of Northern Affairs and National Resources and the data being made available to both departments. You would then have one agency doing hydrometric surveys throughout Canada. There are undoubtedly some examples of that.

Mr. SLOGAN: Do you not think that if there were such a coordinating department we could progress probably much faster in the development of our water resources?

Mr. CÔTÉ: The tempo of the development of water resources, it seems to me, is dependent basically on the use to which the provinces are prepared to put the water resources, and the demand within the provinces.

Mr. SLOGAN: I wonder if anybody else has any questions along this line before I start questioning on another line?

Mr. KINDT: If a soil conservation program for farms were started in Canada, under what department would it function or be administered?

Mr. CÔTÉ: I think that soil conservation clearly in that case would be under the Department of Agriculture.

There might be a case for merging these functions into a separate department, but it is a question of judgment on the part of our legislators whether they want this to be in agriculture or in a separate department, or the way it is now.

Mr. KINDT: I agree with you that it would have to be in agriculture, but I was wondering about the answer to it, in view of the questions which my colleague has brought up, and the divided administration of water resources. It seems to me that something has to give somewhere to make it fit.

Mr. SLOGAN: Would not the Department of Forestry have a great deal to do with water as well as conservation, and then it would not come under the Department of Agriculture.

Mr. CÔTÉ: Yes, there could be something there; but water does not serve forests alone. Sometimes forests serve water resources, as in the case of the Eastern Rockies Forest Conservation Board. That Board's work began 13 years ago for the purpose precisely of steadying and increasing the flows of the rivers which drain the three prairie provinces.

In Canada I think we have witnessed over a period of years a move towards dividing our resources into various fields. Such a move has been, I believe, resisted in the United States.

The present Department of Northern Affairs and National Resources is probably the inheritor of the remaining functions of the former department of the interior. In the United States their department of the interior is relatively intact. There you have an eye being kept on flood control, land reclamation, wild life, and so on.

But here in Canada we have tended to move away a bit from that. You have in the United States, on the other hand, the Department of Agriculture which carries out its functions for the promotion of agriculture. But in Canada, I think, there has been a tendency to fragment more than in the United States. I may be wrong in this generalization, but that is my impression.

Mr. SLOGAN: In the United States they have their corps of engineers which carries on a lot of studies in the water resources program. Do we have any like body in Canada?

Mr. CÔTÉ: Yes. We have our water resources branch.

Mr. SLOGAN: Do we have anything like a comparable scale of personnel?

Mr. CÔTÉ: No, we have nothing like that. But I should add that we have the water resources branch and, in part in another department, in the Department of Public Works, it does harbours work.

Mr. SLOGAN: Do you not think there should be established at this stage, where we are starting on a study of water resources, and where we are going to embark on a large water resources program—do you not think it would be better to establish such a corps of engineers in Canada, or do you think the system we now follow is better?

Mr. CÔTÉ: I think the system we have had has worked effectively; but whether it will in the future, I do not know. I am not so sure in my own mind whether some of the activities carried out in other departments are entirely cognate; but I have not analysed them sufficiently.

Mr. SLOGAN: Would they require engineering studies, and would they go about hiring consulting firms, or how would they go about it in Canada?

Mr. CÔTÉ: It would depend on the particular work you refer to. If you are referring to the Columbia river, this has been studied by the water resources branch, and it has hired a staff over the years to carry out surveys there.

But in fields which were not directly within the water resources branch, or of this department (such as geological surveys) Mines and Technical Services were called in. However, in areas where the particular information was available, let us say in meteorology, the Department of Transport was called in.

Upon occasion when it came to assessing various possible developments of, let us say, the Columbia river, there we have hired consultants to do the specific job.

Mr. SLOGAN: Do you not feel that the hiring of consultants to look into various projects does dissipate a lot of the knowledge they accumulate, because you would not always hire the same consultants whereas, if you had a central body like the corps of engineers, the benefit of their experience in various works would tend to accumulate, and be preserved intact.

Mr. CÔTÉ: I do not know. I am told technology may be transferable, and usually is.

The VICE-CHAIRMAN: Mr. Kindt.

Mr. KINDT: Since I was associated with the army engineers in some of their work at Washington, D.C., for a short time, I might say they, in turn, never, shall I say, take on a watershed, and all the studies involved, by themselves. This is always a cooperative venture. In other words, the army engineers may be given leadership in soil conservation and forestry on a particular watershed, where they are analyzing the water resources and what should be done in the way of building structures to control the behaviour of the stream. On those particular projects, the army engineers will be represented to do certain phases; the hydrology work experts will be there; the economists will be there; the foresters will be there, and so on. In other words, they have a cross-section of people assigned to a particular project. I thought it might be well to say that this is not carried out specifically by one agency, such as the army engineers.

Mr. CÔTÉ: I might also add—and Mr. MacLeod has given me a note on this—that the army engineers make great use of consultants.

The VICE-CHAIRMAN: Have you a question, Mr. Aiken?

Mr. AIKEN: In following up Dr. Kindt's question, is it not true that it would be very difficult to box up water resources in one little department, and try to say that everything goes in here, when the implications are so far flung with other departments?

Is it not, to some extent, better to have a coordinating body such as your department, the water resources department, rather than to try to box everything in?

It seems to me it would be very difficult to bring the whole thing into one group.

Mr. CÔTÉ: Federally speaking, I think that is so, Mr. Chairman.

As I indicated earlier in my talk, the responsibility, or the legislative authority, of the federal government arises out of the constitution which gives the parliament of Canada jurisdiction over certain subject matters.

For example, the authority over fisheries makes it necessary that the area where fisheries are to be made productive are free from abuse—and, hence, you get a certain jurisdiction over the control of water. Likewise, the undisputed federal authority over navigation gives the federal government certain jurisdiction in that field of water use. In addition, there is the authority, for example, in harbours. In the case of certain harbours, the federal government has authority on the prevention of pollution of those particular harbours.

So, there are some complications. It might have to be thought through again if you wanted authority over water problems based on a different constitution. You might bring things together, in certain departments.

Mr. FLEMING (*Okanagan-Revelstoke*): Then, in view of the large measure of control that is vested in the province over water resources, it is virtually impossible to get an absolute centralization of authority in any single department of the federal government, because of the very large control that is given and, constitutionally, it lies with the provinces.

Mr. CÔTÉ: I think that is so.

Mr. FLEMING (*Okanagan-Revelstoke*): No matter what is attempted in this country to coordinate the use of water, the fact remains that the division of authority is established and it is most unlikely that it will change.

Mr. CÔTÉ: That point might well be exemplified by the transfer of resources to the prairie provinces.

As members will recall, until 1930 the administration of resources of the prairie provinces—Alberta, Saskatchewan and Manitoba, plus the railway belt in British Columbia and the Peace river block, was carried out by the federal government. The administration of those lands was carried out by the federal government and the then Department of the Interior. In 1930 the natural resources of these three provinces were transferred to these three provinces, together with the resources of the railway belt and the Peace river block to British Columbia. However, there arose some doubts later on, on the subject of water, and there was a Natural Resources Transfer (Amendment) Act made in 1938, in order to spell out quite clearly that the interest of the Crown in the waters and water powers within the provinces, under the Irrigation Act and the Dominion Water Power Act, was completely transferred to those provinces. Therefore, I think that underlines the point you made. I do not think you would find any province which would wish to retrocede its legislative jurisdiction, so far as it may go, in the waters within a province.

Mr. FLEMING (*Okanagan-Revelstoke*): So, within the federal government, the great problem as has been attacked here, through the formation of this interdepartmental committee, is to coordinate all the various activities, to the highest possible extent, and eliminate, wherever possible, duplication of work within these fields over which the federal government has jurisdiction.

Mr. CÔTÉ: That is correct.

Mr. FLEMING (*Okanagan-Revelstoke*): And that is, I assume, one of the functions of this interdepartmental body.

Mr. CÔTÉ: I would not go quite so far as the aspect you have mentioned in the second part of your sentence, to eliminate duplication. I do not know that the committee of officials has ever been vested with authority to eliminate duplication. However, it does make recommendations on coordination, which may result in the elimination of duplication.

Mr. FLEMING (*Okanagan-Revelstoke*): But it is still conceivable that there could be duplication?

Mr. CÔTÉ: Oh, yes.

The VICE-CHAIRMAN: Have you a question, Mr. Hicks?

Mr. HICKS: Mr. Chairman, I am interested in the first paragraph on page 6, concerning ground water.

Some of you might be surprised to know that the problem of getting suitable well water in the Fraser valley is quite serious. The idea has been mooted that a large pipeline be put in to take the water from the upper end of the valley—that is, from lake Chilliwack or the Vedder river—pipeline this down through the valley, and sell it, as it comes by, to the different municipalities. This subject has been discussed for a number of years. However, a number of engineers have been working recently on this. They have come to the conclusion that it is cheaper to dig wells to some considerable depth, and pump the water by electricity. At the present time, the problem is what is the best thing to do.

Do you know just how far this project has gone? Are there some surveys being made, or is there a report available on the matter?

Mr. CÔTÉ: I do not know, Mr. Hicks, whether there is a report available on that particular subject. However, I do know, on the general subject of

ground water surveys, a matter of three years or so ago the advisory committee on water use policy considered there were too few ground water surveys being carried out on a systematic basis throughout Canada. It recommended to the government that there should be a systematic and continued effort carried out for the ascertainment of ground water conditions as they develop over the years throughout Canada. As a result the government increased the personnel and assigned the task to the Department of Mines and Technical Surveys, as it is more closely associated with the geological conditions across the country.

Mr. MARTEL: I would like to know from Mr. Côté if the first water diversion at Chicago was authorized through the international joint commission? Was it authorized through the treaty of 1909 with the United States?

Mr. CÔTÉ: Mr. Chairman, in answer to Mr. Martel's question, I should like to point out that so far as this boundary waters treaty is concerned lake Michigan is not a boundary water; it is a water which may flow into boundary waters. The only provision in the treaty which directly affects lake Michigan is a provision giving rights of navigation on lake Michigan. The diversion at Chicago was carried out as a domestic affair within the United States. In the 1930's when the diversion increased very materially the neighbouring states —the states adjacent to lake Michigan which were being affected—and other parts of the United States joined in a petition to the United States supreme court asking that the diversion be reduced. I believe it had climbed up to something like the order of 15,000 cubic feet per second and the United States supreme court in the 30's ordered that the diversion be reduced. Today, it is something in the order of 3,000 cubic feet per second. This was carried out at that time as a domestic matter. More recently the concern which has been expressed over increases in the diversion at Chicago have been expressed on the one hand by the federal government of Canada and on the other hand by neighbouring states in the United States.

Mr. MARTEL: But the United States still hold the view that Lake Michigan is not a boundary lake.

Mr. CÔTÉ: It is not a boundary water.

Mr. MARTEL: But it is within their boundary. Yet, according to the reference you made in connection with the international joint commission, you stated that the flow or level of these waters cannot be affected without the agreement of both countries or the international joint commission. Certainly, if the level of Lake Michigan is lowered, that will affect the other Great Lakes; and I do not see how, if they have to come to an agreement with Canada, the United States can maintain that opinion. Of course, it is a controversial matter.

Mr. CÔTÉ: I think this is one of the most complex problems in international law and in domestic jurisdiction. There is no complete agreement on this subject, Mr. Martel. I think that, clearly, Lake Michigan is not a boundary water.

Mr. MARTEL: No.

Mr. CÔTÉ: Clearly, major diversions out of Lake Michigan will have an effect on boundary waters; clearly Canada has stated its position, that it opposes any further diversion which will materially affect the common rights of Canada and the United States from the point of view of navigation and power use of these waters.

Mr. MARTEL: Has Chicago, or the state of Illinois, mentioned any interest in what you would call compensation, or paying for the additional water? Have they shown that they feel it is their water? That is their own opinion, of course. The other states 'round the Great Lakes do not have the same

opinion. But Chicago or Illinois have not shown any direct interest for a compensating water diversion project of some kind, with an agreement between the states and Canada?

Mr. CÔTÉ: Not to my knowledge.

The VICE-CHAIRMAN: Gentlemen, it is five minutes to eleven. The house—

Mr. MARTEL: Mr. Chairman, I have one more small question, if you will permit me. Mr. Côté, you mention on page 5 of your brief, reports on the Chicago diversion both in 1957 and 1959 to the advisory committee on water use policy. Could these reports, which have been discussed at these meetings, be tabled or filed some time later?

Mr. CÔTÉ: I think this would be difficult, Mr. Chairman, because these are views of officials to their ministers on this subject.

Mr. MARTEL: Which are confidential?

Mr. CÔTÉ: Which are confidential. But I merely wanted to inform the committee that these subjects had been discussed at the official level and that views of officials had been made known to the ministers on these subjects at those dates.

Mr. KINDT: Mr. Chairman, will Mr. Côté's report be part of the official record?

The VICE-CHAIRMAN: Yes.

Mr. SLOGAN: Mr. Chairman, I am not going to belabour this point, but I have a suggestion. I think the greatest service this committee can render to the country is if it comes out with a definition of navigable waters. I have been trying to get a definition from various people ever since this committee started sitting, and I have not been successful yet. I have noticed that even in a very small sphere, such as river bank erosion, I was led on a wild goose chase from the provincial to the federal government, and ended up nowhere.

I think Mr. Côté stated that there was some clear legislative authority on the part of the federal government. I think it is about time it was clearly defined, what responsibility the federal government has, so that we can assume that responsibility, and not shirk it.

The VICE-CHAIRMAN: Thank you, Dr. Slogan, for those observations. I am sure the committee will take it up when drafting their final report. It being four minutes to eleven and the house is sitting at 11:00 o'clock, may I call it 11:00 o'clock.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960



STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 17

---

MONDAY, JUNE 13, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESS:

Mr. G. J. Matte, Associate Director of Rehabilitation, Department of Agriculture.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23274-4—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

MONDAY, June 13, 1960.
(18)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Aiken, Hicks, Korchinski, Martel, McFarlane, McQuillan, Nielsen, Payne, Robichaud, Simpson, and Stearns.—(11)

*In attendance:* Mr. G. J. Matte, Associate Director of Rehabilitation, Department of Agriculture. *From the Department of Northern Affairs and National Resources:* Mr. E. A. Côté, Assistant Deputy Minister; Mr. K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; and Mr. R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Mr. Matte and he made a statement on prairie farm rehabilitation activities as related to water development and land use and was questioned thereon.

Copies of the Annual Report 1958-59—Prairie Farm Rehabilitation and related Activities, were distributed to members of the Committee.

At 10.55 a.m., the Committee adjourned until 9.30 a.m. Tuesday, June 14.

M. Slack,
*Clerk of the Committee.*



23274-4—1½

# EVIDENCE

MONDAY, June 13, 1960.

The CHAIRMAN: Gentlemen, we have a quorum.

Mr. ROBICHAUD: Mr. Chairman, before we proceed with this meeting, I think the members of this committee should have an idea of when we intend to adjourn or complete our meetings. Here we are, with the house sitting from 11 a.m. until 10 p.m., and tomorrow—

The CHAIRMAN: Mr. Robichaud, just let me say a word. Tomorrow is the last meeting at which we plan to have witnesses—unless you ask for somebody else, Mr. Robichaud.

Mr. HICKS: That is the best news I have heard this year.

Mr. ROBICHAUD: It has been more like a study group than a committee —which is not the purpose of this committee.

The CHAIRMAN: Order, gentlemen. We have Mr. Matte of the P.F.R.A. with us this morning to tell us about the work of the P.F.R.A. He has a short brief, and then he will be prepared to answer any questions from the members of the committee.

Woud you please proceed, Mr. Matte?

Mr. G. J. MATTE (*Director of Rehabilitation, Department of Agriculture*): Mr. Chairman and gentlemen, first I want to say how glad I am to be with you today. I will try to make this as brief as possible. The activities of P.F.R.A. are so broad that it would take possibly more time than allotted this committee to cover all the aspects of it. However, I have prepared a short paper which I will just read to you, and then I would be glad to answer any questions on detail afterwards.

I have entitled this paper, "Agricultural rehabilitation as related to water development and land use."

Reclamation and development in the Department of Agriculture are those activities which provide for the better use of land and water. For many years the government of Canada, through the Department of Agriculture, has provided services and financial assistance when problems have arisen in connection with the land and water resources of this country. The problems have been such that they are usually beyond individual, municipal, or provincial control. The program, broadly, has been essentially on the self-help plan.

Unquestionably, the greatest of a country's assets is the land. This is particularly true of a country such as ours and the security of our economy is necessarily based on a sound and prosperous agriculture.

In a country whose development has been slow and gradual there is little likelihood of mistakes. But with the very rapid settlement and development of agriculture in Canada, and particularly on the prairies in the last 50 years, it was inevitable that some serious problems should arise. Some of these were on such a scale that they are considered of national importance and therefore should be dealt with from this viewpoint. Thus the federal government undertook measures with a view to not only avoid mistakes but to correct them. In some instances the problem was the lessening of damage caused by extraordinary climatic conditions, such as the drought of the thirties on the prairies—there were flood and drainage problems—and, the very important problem of preventing further deterioration of land from the indiscriminate settlement of unsuitable land.

It is difficult to assess what the agricultural reclamation or conservation program has accomplished over the years, but it has been said that it has added the equivalent of an average sized province in high producing cropland, in power and industry, in production, in opportunities, in livelihoods, in homes and families, in taxes, and in trade. Yet the program is in many ways still in its beginning.

The operations of the Department of Agriculture have greatly expanded the research work for basic information to guide an active program. The department's active program now operates under a number of authorities, the most important being the Prairie Farm Rehabilitation Act and related activities, which I shall endeavour to describe today.

This act was passed in 1935 and amended in 1937, 1939 and 1941. It provides that works may be undertaken to rehabilitate certain areas in the prairie provinces even though the constitutional position is that such works are the responsibility of the province or the municipality. There were, however, a number of special circumstances which justified P.F.R.A. Included in these is the fact that the federal government administered all the resources of the area, including land and water, during its period of settlement, and the further fact that there was reason to believe at that time that a very large area was subject to drought so severe and of such duration as to make permanent residence difficult, if not impossible, without conservation and distribution of water. The experience in the thirties substantiated that belief. The federal government, therefore, set up P.F.R.A. under which the settlers, the municipalities, and the provinces are assisted to rehabilitate the area.

The two major phases of P.F.R.A. work are water development and land utilization. The administration of the act is broad in its scope to meet the problems of rehabilitation and is flexible enough to enable joint policies with the provincial governments, the rural municipalities, and with the farmers.

The water conservation program is designed to conserve and make the maximum use of the water resources of the prairies and to minimize the problems of drought. Advisory, engineering and financial assistance is supplied to farmers and communities to build water storage works, and irrigation projects are developed where feasible.

Briefly, since 1935 approximately 63,000 small water conservation projects have been built in western Canada under this program varying in size from individual farm dugouts and small irrigation projects to community dams. In addition, large irrigation projects such as the St. Mary and Bow river irrigation projects in Alberta, and the South Saskatchewan river irrigation project, with a total potential of $1\frac{1}{4}$ million irrigable acres are being developed. Then in British Columbia nine irrigation projects consisting of over 7,000 acres, for the most part in the Okanagan valley, have been constructed for the re-establishment of veterans on small irrigated plots for fruit growing. Also the reclamation of about 135,000 acres of excellent farm lands between the Carrot and Pasquia rivers in Manitoba was completed in 1959 by constructing a system of dykes and drainage works.

As to the 63,000 small water conservation projects I mentioned as having been built since 1935, I should like to emphasize the importance of these to the farming economy, and especially to the area known as the Paliser Triangle, which is subject to drought, and in parts of which the farmers had to haul their water for a long distance, even for domestic purposes. This difficulty is gradually being overcome by P.F.R.A. constructing catch basins for the spring run-off where feasible. These catch basins consist of small dugouts or farm ponds, stock-watering dams, and small irrigation schemes. The program has

become so popular it is difficult to deal with the many applications. Under this program engineering services are supplied free and the following grants are paid:

| | |
|---|---|
| Dugout | $ 250 |
| Farm dam | 300 |
| Small irrigation project | 600 |
| Neighbour project | 1,000 |

These grants are on the basis at 7 cents per cubic yard for earth moving and 25 cents per ton for rock work. The farmer pays the difference between these prices and what he actually has to pay, which is considerably more, depending on the locality. The grants average about one-half the total cost.

As an example, if a farmer wanted a dugout and his application is accepted, we would instruct him to go ahead and build the dugout. We supply him with all the data—all the particulars required; the size of it, and so on, and he hires someone to do it.

The man, with a bulldozer or scraper, is going to charge him 12 cents or 14 cents a cubic yard. We pay up to 7 cents, and the farmer pays the difference. As I said, we pay up to 7 cents, but not exceeding $250. It works out about fifty fifty.

For larger projects that benefit a group of farmers, which we call community projects, it is the practice for P.F.R.A. to assume the capital cost of the storage and connecting works, and for the municipality, the province, or the water users' association to assume responsibility for the distribution system and the operation of the project.

With regard to the large irrigation projects such as the St. Mary and the South Saskatchewan project, individual agreements are entered into with the province. The practice is for Canada to supply the engineering and to construct the main works, such as the dams and the main canals, and the province constructs the distribution system. Financially this works out to about 50-50 in the end although it may take many years.

Under the land utilization program it is intended to make the best use of the land in relation to productivity. Lands which are low in productivity, because of poor quality or lack of rainfall, are withdrawn from cultivation and returned to grass cover for pasture purposes. Farmers from such lands are moved to irrigation developments. Abandoned lands are re-grassed and developed into community pastures. The withdrawing of lands from cultivation is done in cooperation with the province. The province obtains many of these lands from the municipalities although some are bought outright.

63 community pastures containing about 1,825,000 acres have been constructed since 1935, which handle about 120,000 head of cattle each year, owned by nearly 6,000 farmers. This has been accomplished at a total cost of construction of approximately $6 million.

That includes the cost of land fences, buildings, etc., and the cost of watering places as well. That is the total cost. The revenue from the pastures to date has slightly exceeded the costs of operation and maintenance.

Large areas of these community pastures were at one time considered lost through extreme soil drifting but they have been re-seeded to grass and the drifting has not only been checked but they are again productive in that they supply excellent and profitable pasture. Therefore, these lands have not only been reclaimed, but as a result of a system of pasture management which P.F.R.A. has established, they are being protected from the abuses to which they were subjected in the last 40 or 50 years.

The stockwatering problem in these areas was solved by constructing dugouts and stockwatering dams. This community pasture program is, I believe,

one of the finest examples of conservation being practised. The effects of it have not only been to make the land productive, but it has enabled the 6,000 patrons of the pastures to diversify their farming operations. As you are all aware, the bane of many farmers on the prairies is that because of lack of pasture they must confine their farming to grain growing only. Two or three successive crop failures can put such farmers out of business. Now, those 6,000 who have access to a community pasture can keep a small herd of cattle, the proceeds from which will easily tide them over in crop failure years.

Now, I think that is the important part of this program. These programs of small water development and the building of community pastures are examples of true conservation. The improvements in prairie agriculture that have resulted from these programs are very evident. Only 40 to 50 years ago large areas of the plains did not have a settler on them as far as the eye could see, and these plains were dotted with sloughs—even small lakes—which were filled with water from the spring run-off, and abounded with wild fowl. However, with the advent of homesteaders, and the scramble for land, the breaking of the plains and the building of roads, most of the sloughs and some small lakes disappeared. Following this, the water table dropped and many wells went dry. This made it necessary for many farmers to stop raising stock and depend on grain growing alone for a livelihood, which, as everyone knows, is a very hazardous occupation. What we are trying to do under P.F.R.A. is not only to restore as many as possible of the natural catch basins on the plains, but to create new ones where possible. This is done, as I said before, by constructing dugouts and dams, thus retaining as much as possible of the spring run-off and enabling farmers to practice a mixed farming economy. Unquestionably the very large increase in livestock production on the prairies in recent years has been possible largely because of these programs. There is no question about that.

The Prairie Farm Rehabilitation Act is administered by a director who is located in Regina where the headquarters have been established, and an associate director in Ottawa, both of whom are responsible to the Deputy Minister of Agriculture. The headquarters organization in Regina is divided into three main branches, the water development branch, the community pasture branch, and the engineering services branch. Other divisions located in Regina are: the administration division; the construction, equipment and supply division; the land division; and the planning and information division. The number of persons employed is 1165, 74 of whom are seasonal.

I should like to make special reference to our engineering services branch. Because of the size and nature of the works carried on by P.F.R.A. it is necessary to have an extensive establishment covering several engineering fields; for example, hydrology, soil mechanics, design, air photo analysis and engineering geology, surveys and drainage. The branch has been gradually built up over the years as the program of works has enlarged and we now have an engineering organization that is second to none in these fields. We now employ 113 engineers assisted by a large technical staff. As a matter of fact, our engineering branch is quite frequently called upon to do work for other departments of government and provincial governments; but is able to comply with only a few such requests.

The total expenditures made under the Prairie Farm Rehabilitation Act and under special votes administered by P.F.R.A. in the 24-year period April 1, 1935 to March 31, 1959, amount to roughly $144.3 million, and the revenue received in the same period—$8.8 million. In the early years the expenditures were small in comparison with those at present. At first they were from $3 to $5 million per year, and then they gradually increased to from $10 to $12 million. In 1960-61, because of the construction of the South Saskatchewan

river dam, the total expenditures may reach $24 million. (If any of you are interested in a detailed breakdown of expenditures you will find rather comprehensive statements and other interesting data in the 1958-59 annual report of P.F.R.A. activities, copies of which have been distributed to you.

I think some of you have received that already, because it was tabled in the House of Commons very recently.

P.F.R.A. activities are so many and varied it would take much more time than the two-hour period of this meeting to go into detail. All I have endeavoured to do is give you a general outline of the programs under way, and explain, in a few words, the policy or terms of reference, and the administrative set-up. If any of you would like me to go into more detail on any specific activity, I will do my best to answer your questions.

This report which has been distributed to you possibly will give you some ideas. I would be glad to answer any questions which are put to me. Thank you.

The CHAIRMAN: Thank you, Mr. Matte. Gentlemen, have you any questions?

Mr. KORCHINSKI: I have a few questions. They may have to do with policy and I do not know whether or not they are proper. I will ask them and if they are not proper, Mr. Chairmman, you will so advise me.

Presently the P.F.R.A. permits each farmer to construct one dugout on each quarter. In many instances some of these dugouts are filled in again because of the silt or because of other reasons and are not quite as suitable as they might be. Is there any intention of revising the policy or of changing the plans in such a way that these farmers could have assistance either to dredge these dugouts or construct new ones with the assistance of your branch.

Mr. MATTE: That has not been given any thought in recent years. As I mentioned a few minutes ago, we have more applications than we can deal with at the present time. The policy has been to restrict our activities to construction alone. We feel that the cleaning out of these dugouts is maintenance which the farmer should look after himself. If the day comes when we can deal with all the applications, then some consideration may be given to that; but at the present time we feel we should devote our activities only to new applications.

Mr. KORCHINSKI: Would your answer indicate there are more applications than the department possibly can handle?

Mr. MATTE: That has been the case for a number of years.

Mr. KORCHINSKI: Are there any cases where the applications have been refused?

Mr. MATTE: Not being close to our office in Regina I am not in a position to say. I do not think we have refused, but just have not been able to deal with them all each year. We have a carry-over each year.

Mr. KORCHINSKI: I know that in many municipalities there is a backlog of applications, but in many cases these are not pressing. In a wet year perhaps the demand is not so great, but when it turns dry the demand is increased again. Would it be fair to say that the department in no case refuses, provided the work has to be done, and that the grant will be given, whether in one year or the next? In no cases are dugouts constructed where no assistance has been given.

Mr. MATTE: It would be fair to say that.

Mr. KORCHINSKI: You mentioned that the west has diversified its agricultural methods as the result of water being available. In this committee we are concerned primarily with conservation of water and making water

available. Has any consideration been given to assisting farmers in the construction of wells, that is drilling wells? Has the branch assisted them in the same way they assist them in the construction and development of dugouts?

Mr. MATTE: The attitude has been this: in respect of digging a well where water is available at a reasonable depth, say 30 or 40 feet, it is felt that is something the farmer can do himself perhaps with the help of his neighbour. All it requires is a shovel and muscle. Therefore, we felt that is something which the government should not subsidize. Going back to the matter of the dugout, the farmer is not able to hire the equipment. It takes a caterpillar tractor and so on; that is beyond the ability of the farmer and that is the reason there is a subsidy.

With reference to the drilling of wells, it is felt the risk is too great. One does not know how deep it will be necessary to go—maybe 100 feet, 150 feet or 200 feet, and then there is no guarantee. In certain areas of the west when you do strike water it is not potable; even the livestock will not thrive on it. It has chemical compounds which are bad for the livestock. In such an area we would rather limit our subsidy to a dugout where they would catch the surface water.

Mr. KORCHINSKI: In my area I think we went down 360 feet and did not get water. Eliminating all the other possibilities, if and when the water is found, if it is of a suitable type would your branch consider assisting a farmer in such a case where it has been proven the water is good?

Mr. MATTE: No consideration has been given to that. It would be very difficult to administer. Also for the other reasons I mentioned, the gamble is too great of drilling and not finding water.

Mr. KORCHINSKI: I have one more question. I have in mind the P.F.R.A. boundaries. At the moment there are only certain areas which are qualified for assistance under this particular program. How much progress has been made towards extending this program?

Mr. MATTE: I am afraid I cannot answer that because it is a question of government policy; it is something which is decided at a higher level.

Mr. KORCHINSKI: Would the present P.F.R.A. setup as it is at the moment become part of the study that is being conducted under the soil and water conservation program, or would this still remain a separate scheme? Would it be advisable to have it under that?

Mr. MATTE: I am rather hesitant to reply to that question. As you all know, Canada is now studying the possibility of having a conservation program which would be Canada-wide. The P.F.R.A. only applies to part of the country. I think the idea is to embody the P.F.R.A. in the overall program of conservation; but again that is a matter of government policy.

Mr. PAYNE: The basic interest of this committee, of course, is not directly concerned with agriculture, but rather with the water resources of the nation. I am wondering, Mr. Chairman, if the witness would care to say a few words regarding the availability of water through runoff from spring thaw, or other causes, to supply the catch basins which are mentioned. Has it been shown to be adequate? If you have a drought year will you find adequate spring runoff to supply these reservoirs? If not, what suggestions do you have? Is this work in any way contingent upon the studies and meteorological forecasting in certain areas? Is there a need for more meteorological assistance, or is what you have now adequate? In this connection I have in mind certain testimony which we heard in respect of the South Saskatchewan river. Certain witnesses earlier reported their concern about the availability of the water supply and how the reservoir or storage would be used. Also I am

wondering if the witness would say a word or two as to whether or not the conservation matters in the prairies, which he has been discussing, are undertaken in other areas of Canada such as the Kamloops valley or the Okanagan valley.

Mr. MATTE: In reply to your first question, generally speaking, we have found that the runoff from the snow is almost sufficient to supply the needs of the farmers. In an exceptionally dry year occasionally we have run across farmers whose dugouts have run dry, but that may last only one year. I would put it this way. It is hard to estimate, but I would say the runoff if properly gathered in catch basins will do possibly a 90 per cent job. It would take a succession of dry years to cause much damage.

Just to remind you, as an example you probably have motored across the prairies and have seen the deep coulees as you drive along the highway, with a very high bridge across them. Down underneath there is not a trickle of water going by there in the month of July or August. However, if you drive by there in the springtime you will see a real torrent going by. That is the reason for such a large structure. The structure is for the size of the torrent. Now, why let all that water run to waste to the sea. If you build a series of dams all along the coulee and along the little creeks leading into the coulee you will catch that water and retain it for the benefit of the farmers. As I said, after a succession of dry years you may have a few dugouts which will go dry and the water level in the reservoirs will get quite low; but on the whole it is not serious. Does that answer the first question?

Mr. PAYNE: Yes. Generally, even in drought years, you find there is sufficient run-off to provide the catch basin storage you speak of.

Mr. MATTE: Yes, and generally speaking the occasional showers in the summer will keep them replenished.

Mr. PAYNE: What about the meteorological information?

Mr. MATTE: We employ a meteorologist with the P.F.R.A. The experimental farm has one, and we have one with our own organization. We lean on him to a great extent for information. We have not had him with us, however, for very long and we are not in a position to say yet exactly how it is working out.

Mr. PAYNE: Is he with the Department of Agriculture or with the water resources branch?

Mr. MATTE: He is with the Department of Transport, seconded to the Department of Agriculture.

Mr. PAYNE: Would you answer the question in respect of conservation in other areas?

Mr. MATTE: Up until this year we had a special vote which was open to all provinces. Under that vote we did a bit of work a few years ago in New Brunswick and have contributed towards a couple of projects in Ontario. At the present moment we are contributing towards a program of land development in Newfoundland on a 50-50 basis. The older provinces, however, have been a little reluctant to apply for assistance from this fund. I think possibly it is that they are a little jealous of their autonomy and feel they can do the job themselves; I do not know; but it has been open to all the provinces.

Mr. PAYNE: I have in mind the Okanagan area and the Kamloops valley area.

Mr. MATTE: I mentioned in my paper that we had developed nine irrigation projects in the Okanagan valley for the re-establishment of veterans after the war. This was a cooperative venture undertaken with the Department of Veterans Affairs and the province of British Columbia. British Columbia supplied some of the land and built the roads. The Department of Veterans

Affairs bought some of the land and they contributed a little towards the construction of the project. The P.F.R.A., however, did all the engineering and in some cases paid 100 per cent of the cost of the irrigation systems; in other cases they may have paid only 90 per cent. This was done under an agreement.

Mr. HICKS: How many acres would there be in these projects in the Okanagan?

Mr. MATTE: 7000 acres.

Mr. HICKS: Would you tell me exactly where these nine projects are.

Mr. MATTE: You will find them on page 84 of the report.

Mr. HICKS: When were these started?

Mr. MATTE: Shortly after the war. You will notice that the Cawston Benches was completed in 1951, Chase & Johnson in 1951 and Western Canada Ranching in 1950, and so on.

Mr. HICKS: There are no new areas being put into a project of this kind now?

Mr. MATTE: No. There have been some proposed, but that is as far as we have gone to date.

Mr. HICKS: These all are for the assistance of veterans.

Mr. MATTE: Definitely. We had nothing to do with the settling of these. It was done by the Department of Veterans Affairs.

Mr. HICKS: Some years ago the P.F.R.A. did some work in the Pemberton area.

Mr. MATTE: Yes. That was a different type of project; it was a reclamation or flood control project. It came under the special vote I was speaking of. It was under agreement with the province and the Pemberton dyking district.

Mr. HICKS: At the present time or this winter I believe there have been two engineers loaned or allowed to do some survey work in the Fraser valley on the Nicola, Mica and Serpentine rivers. Will there be anything further done in addition to the supplying of these engineers on that project?

Mr. MATTE: That is another question of government policy. I think we had the request for the engineers to do that because possibly other engineers were not available. Our minister agreed to loan the services of these two men to make only a preliminary survey in order to determine what is wrong there and to see what can be done.

Mr. PAYNE: Is that survey underway?

Mr. MATTE: It is underway now; it is only a preliminary survey.

Mr. PAYNE: When do you anticipate completion of the preliminary survey?

Mr. MATTE: Very soon; this year.

Mr. MCFARLANE: Has an application ever been received for assistance to irrigate the bench lands in the lake Windermere valley?

Mr. MATTE: Not that I can recall.

Mr. MCFARLANE: If an application were made, would it be made through the P.F.R.A.?

Mr. MATTE: It would have to be made by the province. The application should be made to the province, and the province would determine whether they would act. We will not accept any application unless it is made by the province.

Mr. PAYNE: These applications from the provincial authority come exclusively from the agricultural department?

Mr. MATTE: Generally speaking, yes.

Mr. HICKS: The provincial minister of agriculture?

Mr. MATTE: The provincial minister of agriculture.

Mr. PAYNE: Have you, in the P.F.R.A. done any sort of consolidated survey as to the potential waters which could be established for storage in needy areas, based on known run-offs, where work has not gone forward and there are not now controls or catch basin systems established?

Mr. MATTE: Oh, yes; we have conducted very extensive surveys here and there.

One example is the Red Deer district in Alberta, a potential irrigation district along the Red Deer river. That has been going on on and off, for years. Also, a soil survey has been going on at the same time.

There are other examples—I just cannot think of any offhand—where a proposal has been made for a small irrigation district, or a large one, in a certain area, and our engineers have made a preliminary investigation of it and submitted a report, and no action has yet been taken.

I am sorry that I cannot give you any examples other than the Red Deer at the present time.

Mr. PAYNE: You say that these proposals are quite extensive; that is, areas where a system of catch basins to control run-off could be established, and are not established. Are you investigating in these areas the creation of a new type of economic development through the water resources; or are you investigating catch basins with these common pasture lands that we were discussing?

Mr. MATTE: I am not quite sure what you mean.

Mr. PAYNE: Perhaps I can define myself a little better. In this first program you were discussing, on the conservation level—I may be in error, not being a farmer; but from the prairies—I take it, where you are establishing these catch basins. Your effort there is not to disrupt the normal type of farming that is going forward in the area now; whereas you get into a major irrigation project, such as the south Saskatchewan or the St. Mary, and you are transforming the whole economic strata of the area.

What I want to know is, are there areas of this previous class, in extent, which have not been the subject of surveys?

Mr. MATTE: In other words, you mean, do we take a block of land and make a study of that to see where catch basins could be established?

Mr. PAYNE: Yes.

Mr. MATTE: And then, whether we have not conducted any work in them?

Mr. PAYNE: I am merely asking you if this would help. Is there work done on water resources, irrespective of where the water resource may be derived from—rain, or spring spring-off, or what?

Have you carried out a comprehensive survey throughout this area of southeastern Alberta, southern Saskatchewan, southwestern Manitoba, setting forth potential areas of development?

Mr. MATTE: Only on possibly the major streams. But we have not pinpointed where all the catch basins could be constructed. We have made studies of the main streams, however.

Mr. PAYNE: Can you give the committee an idea of the relationship of the areas so serviced now, as to the potential?

Mr. MATTE: I am afraid not. That is a provincial responsibility. I should have mentioned this as we were talking earlier. When an application is made for a community project that application must be approved first by the water rights branch of the province. It is really their responsibility to determine whether a water project will be built at a certain place.

Mr. PAYNE: Are such water resource studies, water use studies, in being in these provinces for these areas, or are they not?

Mr. MATTE: Yes, I would say—to a limited extent. I know our engineering staff is working in cooperation with the water rights branches of the departments of natural resources in each province. They are working hand in hand, continuously; and no survey of a project is made until it has been approved by the water resources branch of the province.

Mr. PAYNE: But there are no general conferences in the general area, or in the three areas, as far as the provincial authorities go, which give you an over-all picture of potential land usage in relation to the conservation of water resources?

Mr. MATTE: I do not think so. It has not been done in the detail which you have in mind.

Mr. PAYNE: Would it be helpful?

Mr. MATTE: It would.

Mr. PAYNE: Would it be costly?

Mr. MATTE: Oh, it would be costly.

Mr. PAYNE: In what magnitude—have you any idea at all?

Mr. MATTE: You would have to consider many aspects of such a program. You would have to bring in the urban needs of water, the agricultural needs, domestic, and so on.

If I understand your question correctly, all these factors would have to be taken into account in working out a master plan.

Mr. STEARNS: Up to the present time you have spent about $13 million in survey and engineering costs. What is the total area that you have to take into account?

Mr. MATTE: We have, for example, the St. Mary project in Alberta, which is a tremendous project. We have the Bow river project, in Alberta; we have the South Saskatchewan, in Saskatchewan; and we have these land reclamation projects which we have developed. That includes the engineering for all these projects in British Columbia, the engineering for these 63,000 small projects, and the engineering for many that have not yet been constructed, or may never be constructed.

Mr. STEARNS: I was just wondering if that is what Mr. Payne was leading up to, the cost of surveying—

Mr. PAYNE: From the figures taken from your report, these represent in all cases, 50 per cent, approximately, of the cost of surveys; the province having met the other half; is that right—or are the survey costs yours?

Mr. MATTE: The survey cost is 100 per cent ours.

Mr. PAYNE: That brings up the point I was trying to get at; that is, land use in relation to the application of water resource.

Perhaps I am confused; but we seem to be in one of those strange Canadian fixes here, where the request for such must come from the province, and the work is done by the federal department. Have the provinces not indicated any desire to have this relationship studied on a long-term basis? Are we going to more advanced studies than we are now?

Mr. MATTE: Am I correct in assuming that you have in mind a master plan for a whole area?

Mr. PAYNE: I do not say, a master plan; I say, an over-all study, where proper usage can be recognized.

It seems to me—I am just putting this to you, not in a critical way—that we are going from patronage to patronage. Are we using our water resources

to their greatest advantage, with all the patronage that this program you outlined offers, to the nation as a whole? Is it being done on any basis where you can set it against the highest and best use of your water resources for your land recovery, or your land utilization?

Mr. MATTE: The three western provinces and Canada have set up what we call the prairie provinces water board. The purpose of that is explained here. That may answer your question. Anyway, this board has representatives on it from each of the three prairie provinces, and the federal government.

Mr. PAYNE: It was outlined to us, actually, sir, by a series of previous witnesses; and that is what prompts the question that I am now putting forward, because I, for one, sitting on the committee, was not at all convinced that this water resources board had any authority to conduct an inquiry beyond a straight line drawn across the map which represents the provincial boundary.

I have not been sure that this provincial boundary was not presenting quite an obstacle which nobody was prepared to hurdle, federal or provincial.

I was of the opinion that in fact we are letting something of this nature develop, which was making inconclusive the study of usage of water resource, and land utilization as a result of that water resource, because we were letting obstacles crop up which do not give proper authority to these various bodies to have a look at the thing on a broader scale, which could perhaps do the nation a great deal more good.

Mr. MATTE: The prairie provinces water board, of course, does recommend allocations of water for each inter-provincial system. Then the province, where this allocation is made, determines what water development projects shall be built, or shall take place within that allocation.

So the duties of the prairie provinces water board are strictly advisory. But to a great extent, I will grant you, the work is more or less of a patchquilt type.

Mr. PAYNE: What we ran into in the previous evidence was this. From a couple of the witnesses we discovered, I am quite sure, as a committee, that the people from Manitoba and Saskatchewan discussed lack of information in the prime supply areas of the waterways and their sources stemming in the Rocky Mountain regions of Alberta. They hit this fictitious boundary line drawn on the map, and were unable to hurdle it. Is this a field that should be explored, for proper utilization of the water resource?

Mr. MATTE: I am afraid that would have to be done possibly on a federal level.

Mr. PAYNE: Is this being done?

Mr. MATTE: Not that I know of.

Mr. HICKS: Would not a proposition of that kind be included in this new proposed amalgamation of P.F.R.A. as a conservation program for water and soil?

Mr. MATTE: That is my understanding. Such a program would bring it out on a national policy of conservation.

Mr. PAYNE: Will you tell us about this, because we do not know about it.

Mr. MATTE: I am sorry; I am not in a position to explain this, except—

Mr. HICKS: That is a policy matter.

Mr. STEARNS: Is this something that will come up in the 1961 conservation meetings?

Mr. MATTE: That is my understanding: the "Resources of Tomorrow" conference is studying that very problem.

Mr. PAYNE: It is the work of this committee to know about that this year; hence my questions.

Mr. SIMPSON: Mr. Chairman, I would like to ask another question on that aspect of it. The P.F.R.A. have almost completed a reclamation project in the Pasquia area. Am I right in assuming that, on completion of that, the distribution of land in that area, and the amount of money that will be charged for that land, and who gets the land, is a matter for the provincial authority?

Mr. MATTE: Definitely.

Mr. STEARNS: It is the provincial authority which establishes that?

Mr. MATTE: Definitely.

Mr. SIMPSON: Could you give us just a brief idea of the policy of P.F.R.A. in this respect? I see where P.F.R.A. has spent something over $2 million on this project, according to the figures that we have here. Is there any money recoverable by P.F.R.A. from such projects?

Mr. MATTE: Yes. This project was undertaken under an agreement with the province. Canada undertook to construct the reclamation works; that is, the drainage ditches, dykes, install the pumping stations where necessary, and so on.

I am sorry that I do not have this agreement here; it was amended once or twice. The province has assumed the responsibility for the distribution of this land, or the selling of this land to settlers, and Canada is to get a part of the selling price of this land as a refund of its expenditures. I am sorry that I cannot tell you what the exact amount would be as it is on a percentage basis.

Mr. SIMPSON: I was wondering if the authority for the distribution of that land is in provincial hands.

Mr. MATTE: Entirely.

Mr. SIMPSON: Is there anything in the agreement, that you know of, that the price of the land is set in relation to the actual money spent on the land?

Mr. MATTE: No, the price of the land was left to the discretion of the province.

Mr. SIMPSON: I suppose you could not tell us this. In relation to that specific project, there were a number of small marshes, sloughs, and things that had been drained. But there are two fairly large bodies of water, Pasquia lake and Big lake, in that area— and is the plan eventually to eliminate them, or are they going to be left there as water storage?

Mr. MATTE: I am sorry, I do not know. That is a engineering phase of it with which I am not acquainted.

Mr. SIMPSON: You do not have the information here?

Mr. MATTE: No.

Mr. KORCHINSKI: Do you know what area that would cover in Saskatchewan, if anything?

Mr. MATTE: The total area of the Pasquia project is 135,000 acres, all in Manitoba.

Mr. KORCHINSKI: There is none that would extend into Saskatchewan?

Mr. MATTE: It does not extend into Saskatchewan. However, in that whole area some half a million acres, I understand, can be reclaimed, and the additional area would extend well into Saskatchewan.

Mr. KORCHINSKI: Would that require extra work?

Mr. MATTE: Oh, yes.

The CHAIRMAN: Would that be reclaimed at the expense of water storage?

Mr. MATTE: No.

The CHAIRMAN: No: my question is, would you be sacrificing water reservoirs to reclaim that land?

Mr. MATTE: Oh, no. There, it is a question of too much water.

Mr. KORCHINSKI: In such cases, how did the P.F.R.A. enter into this scheme, since P.F.R.A. is primarily interested in conservation of water?

Mr. MATTE: As I mentioned a few minutes ago, up until this year the P.F.R.A. had a number of special votes: one for major irrigation projects, one for reclamation—and this came under the reclamation vote, which consisted of drainage, flood control, and so on. That is why we call this P.F.R.A. and other related activities.

However, this year we have amalgamated all these activities under one vote, as you will recall.

Mr. KORCHINSKI: In other words, from now on you cannot expect to do any more reclamation; is that right?

Mr. MATTE: Yes, we can. I have not got the book of estimates here, but it is a very lengthy title. Most estimates titles are short. We have combined all the votes into one, making ours quite long. I have been given the estimates book. We call it irrigation and water storage projects in the western provinces, including payments in the current and subsequent fiscal years, in accordance with the agreements of July 25, 1958—that is, the South Saskatchewan project, relating to the South Saskatchewan river project. Then, there is a semicolon. That refers to the large irrigation projects. Then, we have the Prairie Farm Rehabilitation Act program, semicolon, and land protection, reclamation and development. We have all of them under one vote now. There is a different policy for each one of these sections of that vote.

Mr. KORCHINSKI: Is there no case where there is co-operation with the province, like the channel and ditching program in Saskatchewan? Is there any co-operation under this particular protection and reclamation development program?

Mr. MATTE: No.

Mr. STEARNS: I have one further question.

I am referring to page 88 of your booklet. What becomes of the revenue that you received up to 1959?

Mr. MATTE: It goes back into consolidated revenue.

Mr. STEARNS: In other words, on an expenditure of $144 million, you get back $8,798,000, or over 6 per cent

Mr. MATTE: It just went back into the bank.

Mr. STEARNS: So, really, we are making money out of this. However, it does not go back to the provinces; it just goes back to Canada.

Mr. MATTE: Yes, to Canada. This revenue consists of water rates, community pasture fees and, sometimes, the disposal of some land. Anything we collect goes into revenue, and is broken down into these various headings.

The CHAIRMAN: Gentlemen, as the house will be sitting shortly, shall we adjourn.

Some hon. MEMBERS: Agreed.

The CHAIRMAN: Thank you very much, Mr. Matte. I am sorry that we have not had more time to receive your subject.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

---

STANDING COMMITTEE

ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

---

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 18

---



TUESDAY, JUNE 14, 1960

---

Estimates 1960-61 of the Water Resources Branch of the Department of Northern Affairs and National Resources.

---

WITNESSES:

Mr. A. F. Paget, P. Eng., Comptroller of Water Rights, Department of Lands and Forests, Province of British Columbia; and Mr. Alfred Joseph Whitmore, Director of Pacific Area, Federal Department of Fisheries, Vancouver, B.C.

*From the Department of Northern Affairs and National Resources*: Mr. A. E. Côté, Assistant Deputy Minister.

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23318-9—1

STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*),
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

# MINUTES OF PROCEEDINGS

TUESDAY, June 14, 1960.
(19)

The Standing Committee on Mines, Forests and Waters met at 9.30 a.m. this day. The Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Doucett, Fleming (*Okanagan-Revelstoke*), Hicks, Kindt, Korchinski, MacRae, Martel, McFarlane, McQuillan, Payne, Rompré, Simpson, and Stearns. (13)

*In attendance:* Messrs. A. F. Paget, P. Eng., Comptroller of Water Rights, Department of Lands and Forests, Province of British Columbia, and Alfred Joseph Whitmore, Director, Pacific Area, Federal Department of Fisheries, Vancouver, B.C.; *From the Department of Northern Affairs and National Resources:* Messrs. E. A. Côté, Assistant Deputy Minister; K. Kristjanson, Secretary, Advisory Committee on Water Use Policy; J. D. McLeod, Chief Engineer, Water Resources Branch; and R. H. Clark, Chief Hydraulic Engineer, Water Resources Branch.

The Committee resumed consideration of the 1960-61 estimates of the Water Resources Branch of the Department of Northern Affairs and National Resources.

The Chairman introduced Mr. A. F. Paget, Comptroller of Water Rights, Department of Lands and Forests, Province of British Columbia, to the members of the Committee.

*Agreed,*—That the brief prepared by Mr. Paget dealing with problems relative to water and water use in the province of British Columbia be taken as read and included in this day's evidence. Copies of this brief were also distributed to the members of the Committee.

Mr. Paget summarized his brief and was questioned thereon.

During his presentation, Mr. Paget emphasized various points by referring to a wall map and photographs of various areas in British Columbia.

Mr. Côté, Assistant Deputy Minister of Northern Affairs and National Resources, made a statement on Federal water gauging stations and was questioned thereon.

The Chairman then called Mr. Whitmore, Director, Pacific Area, Federal Department of Fisheries, and he made a statement dealing with the fisheries resource aspect of the studies and report of the Fraser River Board.

At 10.55 a.m., the Committee adjourned until 2.30 p.m. this day.

## AFTERNOON SITTING
(20)

The Committee resumed at 2.30 p.m. the Chairman, Mr. H. C. McQuillan, presided.

*Members present:* Messrs. Fleming (*Okanagan-Revelstoke*), Hicks, MacRae, Martel, McFarlane, McGregor, McQuillan, Mitchell, Muir (*Cape Breton North and Victoria*), Nielsen, Payne, Rompré, Simpson, and Stearns. (14)

*In attendance:* Same as at morning sitting with the exception of Mr. Paget.

Mr. Whitmore was questioned on the statement he made at this morning's sitting.

The questioning being concluded, the Chairman thanked Mr. Whitmore for his presentation and wishes him well as he will be retiring in the near future.

Item 277—Administration, Operation and Maintenance, was called and adopted.

Item 278—Construction or Acquisition of Buildings, Works, Land and Equipment, was called and adopted.

Item 279—Studies and Surveys of the Columbia River Watershed in Canada, was called and adopted.

Item 280—Saint John River—Federal Expenditures in connection with investigations to be carried out by the Saint John River Board, was called and adopted.

Item 281—Fraser River—Federal Expenditures in connection with investigations to be carried out by the Fraser River Board, was called and adopted.

Item 486—Advances to the Northern Canada Power Commission for the purpose of capital expenditures in accordance with sub-section (1) of section 15 of the Northern Canada Power Commission Act, was called and adopted.

Item 487—Advances in accordance with agreements entered into pursuant to the Atlantic Provinces Power Development Act, was called and adopted.

The Chairman announced that a meeting of the committee would be held shortly to draft its report to the House.

At 3.00 p.m., the Committee adjourned to the call of the Chair.

M. Slack,
*Clerk of the Committee.*

# EVIDENCE

TUESDAY, June 14, 1960.

The CHAIRMAN: Order, please, gentlemen, we have a quorum.

We have with us this morning Mr. A. F. Paget, Comptroller of Water Rights, Department of Lands and Forests, Province of British Columbia, who is going to tell us something about the problems relating to water and water use in the province of British Columbia. We have copies of his brief which will be distributed to you. Mr. Paget is just going to summarize his brief, so if it is agreeable to the committee, shall we have his presentation printed as read?

Agreed.

Mr. A. F. PAGET (*Comptroller of Water Rights, Department of Lands and Forests, Province of British Columbia*): In bringing to your attention particular problems relating to water in B.C., it seems desirable to discuss generally some of the inherent advantages and disadvantages concerning land use in B.C., as these aspects also relate to both water use and the particular problems of use as well. The land area of British Columbia, about 366,000 square miles, is mostly mountainous and is traversed from north to south by three major mountain ranges, the coast and Columbia ranges and the Rockies. Differences in elevation of several thousand feet are consequently experienced in a relatively short distance. The major river systems are deeply entrenched in generally north and south valleys, the most spectacular of which is the Rocky Mountain Trench which contains the head waters of the Kootenay river, the Columbia river, the Fraser river, and Peace river and some northerly drainage to the Liard system. The drainage to the principal rivers is by a multitude of tributaries that in total comprise an intricate net many thousands of miles long.

Added to the problems of adverse topography, the complexities of the climate must also be considered. The climate of B.C. is without uniformity and encompasses almost every variation that can be expected within the temperate and arctic zones. Precipitation ranges from extremely humid adjacent to the Pacific ocean to the very arid, near desert conditions experienced in the interior valleys. Temperature conditions vary extensively from south to north and through the variations of elevations, with the warm equitable climates found near the ocean and in the interior valleys, shading by reasons of latitude or elevation to near arctic conditions in the north and on the high mountains.

A detailed description of the climate of British Columbia for that area comprising the Fraser river drainage is given in the interim report of the Fraser river board, Appendix A, published June, 1956, which illustrates to a partial degree the extent of climatic variations in the Province.

Because of the rugged topography and difficulties of communication, much of the population of the Province is concentrated in the valley bottoms and communications such as roads and railways are also forced to occupy these valleys. The result is that most of the land area is uninhabited as the valleys are relatively small in area. Consequently information concerning climatic conditions, stream flows and other pertinent basic data is difficult to obtain in most of the Province and if obtained is done at a high cost.

Although a progressive program has been underway for many years directed to the collection of basic hydrologic data, it is only recently that the people charged with the administration of the water resource have realized how seriously deficiencies of information handicap planning and are beginning to properly appreciate how vitally necessary it is in view of the fast developing economy of British Columbia, to have comprehensive information on the availability of water and the characteristics of run-off. The factors to topography and climate that make it difficult to assess the water resource potential of the Province are, however, attractions that bring people to British Columbia both to live and play. With most of the land use in the valley bottoms, rapid increases of population have in many instances encroached on the natural flood plains of the rivers, which have multiplied the damages caused by erosion and have posed a periodic threat of increasing economic significance to people and property through flooding.

A much better understanding of the climate and hydrology of the Province is necessary if the problems of flood and erosion are to be adequately dealt with and the growing economy is to be served with sufficient water for domestic and industrial purposes, irrigation, recreation and especially if the energy in the falling water can be made available for the use of the Province as well. Resource use and population pressures have been expanding faster than our studies and evaluation of the water resources of the region.

## WATER PROBLEMS ASSOCIATED WITH EXISTING USAGES

Water problems in British Columbia are not in any way unique, but by reason of the diversification of climate and topography this Province is faced with such extremes of availability of water that considerations must be given to flood protection, drainage, irrigation, and water conservation. These problems apply to urban areas, agricultural lands, industry and other resource uses such as fisheries and recreation and are in many cases superimposed on each other. It is likely that there is not a water problem met anywhere in the rest of this country that is not experienced to some degree in British Columbia, and some problems are peculiar only to this region, such as severe winter rainstorms.

Some of the specific problems relating to water use are discussed as follows, although some complicating factors such as other resource conflicts, urbanization and industrialization, are not specially dealt with as this would require extensive treatment beyond what is contemplated in this brief at this time.

### *A. Domestic, Waterworks and Industrial Water Supply*

The population growth of the Province as previously noted has been essentially in the valleys and recently the greatest number of people have found occupations and homes on the southern end and east side of Vancouver island, the lower Fraser valley adjacent to the city of Vancouver, the Okanagan, Fraser, Kootenay and other valleys.

It is estimated that over 250 communities and their industries involving about 80% of the population are supplied with domestic water through water supply systems operated by the municipalities, water utility companies or improvement districts incorporated for waterworks or irrigation purposes. Only about 25 of these systems, mostly very small, are tapping ground-water.

Owing to the great variations in flows of mountain streams between spring freshets and late summer flows, deficiencies of water exist from place to place within all regions of the province. The lack of data on minimum stream flows and on the availability of ground-water in some cases makes it very difficult

to ascertain the reliability of the available water supply for a new community or industry, and makes it very difficult to establish economic and engineering feasibility of proposed projects to provide water for community use. Due to difficult topography and the smallness of the majority of our new communities dictated by our narrow valleys, the average capital cost of a community water supply system is rather high, amounting at present up to about $600 per residence where conditions are reasonably favourable.

### *B. Land Reclamation by Irrigation and Dyking and Drainage*

A rather large percentage of the improved land in British Columbia has been brought into production through reclamation engineering. The total acreage of the improved land is approximately 1,200,000 acres. It is estimated that an area of 200,000 acres is presently irrigated and an additional area of 400,000 acres needs irrigation.

An area of approximately 230,000 acres is protected by major dyking and drainage facilities and it is estimated that an additionl area of 200,000 acres could be reclaimed by dyking and drainage. Most of the areas thus reclaimed need irrigation water for some part of the growing season for optimum production.

Thus, one-third, of the presently improved land is either irrigated or protected by dykes and drainage installations and an area equal to or greater than the existing reclaimed land could be made productive by irrigation or flood control, or both.

#### *Irrigation*

Hydrologic problems similar to those encountered in domestic water supply problems are imposed with relation to the expansion of the irrigated area for agricultural purposes. The climate of B.C. is generally summer-dry and to obtain optimum use of the land area and also to encourage permanent settlement in the uninhabited regions of the province, an aggressive program of irrigation must be carried out. Very good stream flow records on small streams with relation to summer flows are necessary before community irrigation projects can be recommended and their economic feasibility ascertained or in many cases before individual water use can be authorized. Again, because of the difficult topography, community irrigation undertaking are small in size and the cost of bringing water to the area is high, amounting up to $400 per acre in capital cost and to an annual operating charge of up to $30 per acre.

#### *Flooding, Drainage and Stream Erosion*

These problems have become ones of major significance owing to the encroachment on the natural flood plains in the river valleys.

Dyking, drainage and river bank protection works have been constructed and much work is necessary in the future. Major dyking works and the associated drainage facilities require a capital investment in the neighbourhood of $200 to $300 per acre of protected land. A dependable bank protection against erosion by a large stream could cost as much as $50 or more per lineal foot of the river bank.

In many cases the existing protection works are not completely adequate and to ensure that adequacy of design is provided for in the future, a great deal of information is necessary concerning stream flow records; particularly peak discharges and water levels, and also the behaviour of the rivers themselves, such as erosion and deposition in the stream channel. The water rights branch has undertaken studies of suspended sediment in streams within the Province, and where necessary would feel themselves quite competent to

gather this type of data. This does not seem to be a major problem at present in any case. There are, however, matters such as bed load movements along the stream channels and interpretive work in this field that are not carried out by any agency at the present time. It is felt that a good deal of experimentation and observation will be necessary before firm conclusions and recommendations can be made in many cases involving river engineering.

*C. Hydro-Electric Power*

In this field of water resource utilization stream flow records are necessary for the whole year over a long period of years so that any critical dry period that may be expected to recur in the future would be recorded. Good information is necessary as to the maximum flows that may be expected during the life of the hydraulic structures. As investments for hydro-power development are very large, it is necessary to know with as much exactitude as achievable the amount of water available for power generation in order to determine within reasonable limits the economic advantages created by these investments.

*D. Water Quality*

Quality of the natural stream water is an important factor where water is too hard or contains sediments or solutions unacceptable for domestic or industrial use. While the B.C. mountain streams generally carry water of good quality, occasionally the hardness, iron content and other components make it necessary to treat the water. Overall water quality surveys have been carried out by the mines branch of Canada Department of Mines and Technical Surveys and also by some Provincial agencies such as the B.C. research council and the results of these investigations suffice to give a general picture of the natural quality of our stream water. Specific and local problems involving water quality are dealt with by the interested agencies such as the Provincial Health Service, fisheries interests or industries.

Pollution of surface waters has become a problem in more densely populated areas of the province and receives attention from the provincial authorities. Legislation has been enacted providing control of pollution in designated areas through the pollution control board. The Fraser river downstream from Hope at present is the only area under the active control of the board. Again, a good knowledge of the minimum flows of the streams is important to find a realistic solution to pollution problems.

*E. Watershed Studies*

A great deal of our mountainous watersheds is forest land. Timber cutting, as well as grazing, can affect water yield of a small stream, and in altering the regime, problems of erosion and bed load deposition can occur. This is a field where studies of a few representative watersheds should be undertaken by recording stream flow, sediment load, meteorological factors and the man-made change in the cover of the watershed. The information so collected may yield information as to the effect of changes in watershed management to the behaviour of the stream and its flow regime, which information would be very useful in dealing with water and land-use problems.

## COLLECTION AND PROCESSING OF DATA

*General*

That the continuing development of the water resources of British Columbia must go forward if the province itself is to progress is without question. There is also no doubt that further developments will be more costly and create more

conflicts with both existing water and land usage. As the requirement for water increases, the need for knowledge concerning its availability and local behaviour becomes more acute. It is with relation to the procedures concerning the engineering and scientific investigations leading to the accumulation of data for this understanding that the following portion of this discussion will deal.

*(A) Surface Water*

The agencies presently involved directly or indirectly in the collection and processing of data are (1) *Water Rights Branch, Province of British Columbia,* who are responsible for the administration of the water resource within the Province, (It is noted that in the case of British Columbia, water is considered property in the right of the province and the use to this water is granted by a process of licencing). (2) *Water Resources Branch, Department of Northern Affairs and National Resources.* By agreement of many years' standing, the province ceased to formally gauge streams and this work, except for some particular instance, is carried out under this Federal Branch. It is also noted that cooperative studies are carried out by Boards and Agencies or informally between Provincial Water Rights and this Branch. (3) *Meteorological Service, Department of Transport.* Data concerning climate is gathered by this agency and processed and made available to the hydrological services. In the case of accumulation of snow in the mountains of our watersheds, this work is wholly done by the water rights branch of the province of British Columbia. (4) *The Federal Department of Agriculture.* Some work with reference to climate is done in experimental stations and experiments relative to evaporation have largely been conducted by this Agency. (5) *Additional Agencies,* both private and public, participate in water resource investigation. As an example, power companies accumulate meteorological data, assist in snow surveys, operate gauging stations and reservoir elevation gauges. Irrigation districts and some municipalities do similar work. The Department of Fisheries, both Provincial and Federal, also undertakes some investigative work on river flows. The Department of Public Works carries out investigative programs with relation to navigation. Many private people such as resort owners, logging operators, etc. maintain informal records. While this list is by no means comprehensive, it does serve to indicate the diversity of interest and the many organizations that are interested very directly in the problem of water supply and management.

*(B) Ground-Water*

Compilation of ground-water inventory is a task more complex than dealing with surface water supplies. Economically important ground-water bodies in our province exist in most cases in unconsolidated deposits consisting of gravels, sands and solids that have been dumped into the bedrock canyons during and after glacial times. Ground-water that can be found in the bedrock itself, is limited in quantity.

The province has, by amending the Water Act early this year, made provisions for the control over the use of ground-water if and where such a control is deemed necessary. It is intended to gradually intensify ground-water investigations by the Water Rights Branch in areas where large use of ground-water exists or can be foreseen. In the past, the *B.C. Mines Department* has studied ground-water potential in some areas which studies have been mainly based on interpretation of superficial geologic and topographic features of the area and from the data available on existing wells. The *Geological Survey of Canada, Department of Mines and Technical Surveys,* has done similar work, notably in the lower Fraser valley. It is understood that the Head Office of the Geological Survey of Canada is also the central depository of all logs of water wells obtained from well drillers in B.C.

There is an apparent need for more intensive studies of the Pleistocene geology of our Province, that is, studies of unconsolidated sediments of the glacial times when the surface was periodically covered by great glaciers several thousands of feet thick. There is equally a need for initiation of a ground-water observation network, in order to assess the potential of our known ground-water resources, both in quantity and quality.

*Limitations Imposed by Existing Programs of Data Collection*

As an example of the use of basic data required for the planning of river development, the current work of the Fraser river board may be cited. This board has been in effect for about 12 years, during which time it has prepared two reports, one of an interim nature published in 1956 and a letter report entitled "Preliminary Report on Flood Control and Hydro-Electric Power in the Fraser River Basin." In the early years of this Board's work, great emphasis was made on the collection of basic data, both of a hydrologic and meteorologic nature and in addition and extensive program of topographic mapping was promoted. There was very little basic data for the board to use when it commenced its operations and only latterly with the accumulation of a minimum of information has it been possible to reach conclusions and recommendations with relation to such matters as flood control and hydro-electric power development. The deficiencies of basic data for this area are still quite apparent and the Board itself made the following observations in its report: "It was abundantly clear from the outset of the study that the greatest handicap to adequate river system planning would be the lack of long-term meteorologic, snow survey and hydrometric records. Although the Board took such steps as it could to increase and extend pertinent records, there remains a real need to continue and expand the present program for the gathering of basic data."

While the board felt the program for the Fraser River was by no means adequate and recommended its further expansion, it must be remembered that notwithstanding these deficiencies a more intensive approach to the accumulation of basic data was being carried on in the Fraser River than in any other major river basin in the province. The board, of course, did not report on the situation elsewhere in the Province.

The Provincial authorities responsible for the planning of water use find it increasingly difficult to adequately deal with all the aspects of water use and to adequately plan against erosion and flooding. The Fraser River Board through its long involvement with the production of even a preliminary report has certainly pointed up these difficulties. This basin is nevertheless the most settled and the easiest of access of any of our major river basins. Consider the difficulties and delays when such river systems as the Skeena and Stikine, for example, are being examined comprehensively for report purposes, if the studies of the Fraser are to be criteria in this regard.

A difficult situation was also experienced while the studies of the Columbia River in Canada was underway. For about 15 years, a program of mapping and data accumulation went forward before a report was made by the International Joint Commission. It is worthy of note that in this major river basin the mapping is very incomplete and many major river systems tributary to the Columbia river have not received any investigation.

*Meteorological Data*

It is very difficult to disassociate any studies of a hydrologic nature from the allied studies of the meteorologist. A comprehensive and well-directed series of studies with the associated accumulation of weather data specifically directed to giving information through all the ranges of climatic variations must be undertaken to fill out the present program.

As more and more information becomes available, analysis shows that the behaviour of streams can be to some degree reflected from rainfall and other meteorological data, and it is very important that this aspect of data accumulation be developed to the greatest extent possible, far beyond the present treatment now being given in B.C. As an example of the lack of coverage of this nature, a recent examination of the situation in the central northern region of British Columbia, situated west of the Rockies and north of the Canadian National Railway and east of the coast range, shows there is an area of 27,000 square miles without a permanent meteorological station. This area is approximately the size of New Brunswick. Further, as over 80% of the province is at an elevation greater than 3,000 feet, this vitally important area likewise is almost totally devoid of meteorological stations. It is forcefully pointed out that it is from this general region that the bulk of the runoff occurs and for which quite precise information should be obtained. To overcome in part this lack of precipitation data at high elevations, the province of British Columbia has established at high elevations a system of snow surveys that reports on the accumulated snow at intervals both during accumulation and snow melt periods. This procedure has provided a reasonably accurate index from which to predict volume runoff for the period between April to August for the interior streams. However, on account of the factor of rainfall associated with snow melt in the coastal region, unless accurate and extensive meteorological records are available, it does not seem probable that any useful work can be done either in predicting stages or volume of runoff in this region.

While the attempts to forecast total volume of runoff from streams where snow melt is the dominant consideration have been sufficiently successful using the data accumulated at present, the forecasting of flood stages on any major river system has not been attempted owing to the lack of basic data necessary for this purpose. As an illustration of the importance of this matter, the preliminary report of the Fraser River Board recommended as follows: "That the provincial authorities assisted by the appropriate federal authorities, develop and implement a flood forecasting and warning service for the Fraser River."

In order to begin to achieve results in this regard it is considered that it would be necessary to have available the daily temperatures which occur during the snow melt period at strategic locations in the major snow fields and at elevations ranging from 4,000 to 7,000 feet. Modern technological advances have apparently made it quite practicable to construct proper equipment for this purpose although it is recognized that cost greater than presently experienced for meteorological study would be imposed.

From the foregoing discussion it becomes apparent that there is not at present a basic meteorological network operating for the obtaining of data relating to the water use problems of the Province. Unless this network is provided it will be very difficult and time-consuming to recommend solutions to many of the water problems with which the region is now faced.

*Use of Existing Data*

The foregoing sections of this brief have largely dealt with the deficiencies in volume of data, without any comments on the degree of accuracy or usefulness of this data. In the case of the hydrologic material which is published in the volumes entitled "Surface Water Supply of Canada" many errors and inconsistencies occur. As a first step it seems very necessary that all existing published data be carefully scrutinized and authenticated. It is very likely that in the future information on stream flows, meteorological records, etc., will all be processed either on cards or tapes for use in electronic computers and the use of this data will not perhaps be done with the same discretion as must be used at present.

A great deal of data has been accumulated by agencies or individuals which has not been published but would add greatly to the fund of knowledge if it were searches out and made available. Attention is drawn to records and lake elevations obtained individually, such as by resort owners, people associated with navigation, etc., stream flow records of such agencies as Fisheries and Public Works, hydro power utilities and in some cases minimum and maximum elevations have been observed by local settlers. In connection with existing data wherever discharge stations may be located on a stream on which there are substantial lake areas, it is very important that lake elevations be also recorded. Certainly one solution by which data could be expanded rapidly for generalized use would be by the intensification of the program of miscellaneous measurements on as many streams as it was practicable to occupy during the year. Particular emphasis should be given to the maximum and minimum discharges. Later these miscellaneous measurements could be used with an expanding hydrological network.

It cannot be stressed too strongly that the compilations and interpretations of the data relative to stream flows and water elevations is a most important matter and should receive careful attention from the agency charged with this responsibility.

## CONCLUSIONS AND RECOMMENDATIONS

At times of flood or drought, water seems to be one of the great problems of B.C. Then it seems important to do something about correcting the shortage or over-supply that is causing distress and economic loss. For the most part, however, it is taken for granted that there is an abundance of water with the lakes and rivers pleasant or picturesque places created for our enjoyment. There must be an onrelenting effort to alleviate the first conditions if the latter is to be a reality. The taming and putting to work of wild mountain streams is not an easy task but this must eventually be done if British Columbia is to continue to grow with Canada. It is becoming apparent that water is increasingly more necessary to our modern way of life both as regards quality and volume. It is stressed that water is a basic necessity and must not be taken for granted.

It is realized that owing to the infinite variety of climate and elevation within the province, complicated by the tremendous number of tributary streams, a comprehensive program of basic data accumulation to meet the ultimate needs of the province is not at present an economic possibility. It is also realized that in many areas an urgent need for basic data cannot be presently demonstrated. However, it is probable that a better use of existing funds could be accomplished providing all the agencies concerned concentrated their efforts into more specific aspects rather than each meeting the whole challenge on a broad front. The need for information will almost certainly arise before a program is undertaken to obtain same and the recent studies of both the Columbia and Fraser systems are examples of how lack of information seriously delays decisions of much economic significance.

In the matter of the construction of urgently needed remedial works, adequate data is needed as the criteria to develop the most economical engineering solutions. No matter how hard we try today to acquire knowledge and formulate plans for the future, there never will be enough information on hand when the time comes to implement such plans.

Problems relating to water in British Columbia are, as has been noted, very many; some most complex or expensive. There is scarcely a community or localized area without some problem. Many of the smaller matters are being corrected by the local areas when it is in their financial competence

to do so. However, many serious problems exist beyond the local economic competence that require substantial remedial works if the usefulness of a district to the national economy is to be maintained or increased.

The need for assured knowledge of the hydrology of the Province is a fundamental requirement before water problems may be dealt with. It is evident that an expanding program to provide the data upon which this knowledge is based is very necessary. The methods by which this data is obtained, interpreted and presented should be such that the use of the material will not be inhibited owing to inaccuracies or lack of explanatory notations.

The responsible officials charged with the development or administration of water resources will have to go ahead and make decisions on useage and control of water, and these decisions cannot be much better in many instances than the data that has been used. In the future, with a great deal of the easily developed water resource already occupied, finer lines must be drawn as to the factors of availability, quality and stream behaviour if decisions within economic realities are to be made on problems of water use or control.

The CHAIRMAN: Mr. Paget will please continue with his presentation.

Mr. PAGET: Thank you, Mr. Chairman. I feel quite honoured indeed to be able to discuss our problems in this committee. I have placed a map of British Columbia on the easel, in case there is any doubt; perhaps I might have the easel moved over closer to me.

British Columbia, as a good many of you know who have lived there, and as most people know who have travelled through it, is recognized as having quite a large area of mountains. Generally that is quite true. We have, I think, the second largest land area in the dominion of Canada, with some 366,000 square miles.

This province is traversed by three principal mountain ranges, the Coastal range, the Columbia system, and the Rocky Mountains. The interior plateau is indicated by this rather green region through here, and it is not flat by any means. It has quite a substantial number of mountain ranges in itself.

In consequence of the greatly rugged topography, we have a great many rivers and streams. Of our river systems the principal one is the Columbia-Kootenay in this part of the province; the Fraser system draining the central portion of the province, and the Peace river, this part; also the Liard in the northern part, as well as the Yukon in the northwest corner.

Here we have the Skeena, and the Stikine, and several other smaller rivers. All these are really major rivers in themselves; but behind them are many thousands of miles of more minor streams originating usually in the high altitudes, thus they have high velocities, and create the problem of erosion, and flooding on account of this rugged topography.

Because of our comparatively uninhabited aspect we have some real difficulties in acquiring basic data. I have two sets of photographs here, and with the permission of the chair I would like to allow one of those sets to be circulated while I shall hold up the other and explain what I have in mind.

This picture is actually an aerial photograph of the region at Vancouver. Most of the Vancouver area is indicated in this picture. You can see this area behind, showing the rugged mountainous condition of the country adjacent to Vancouver.

I have a second photograph which is a closer-up view of the area which you see just behind here under the clouds. I believe this would be behind the home of the member for West Vancouver. He probably knows it very well. It is quite a rugged piece of country, yet it is only a few miles from the city of Vancouver.

The whole series is just to indicate the relatively small area that is inhabited in the province. Mr. Fleming will recognize this, because this is a view looking down from the end of the lake at the city of Vernon, and looking up towards the Arrow lakes up White Valley. Again, this is probably the second most intensively cultivated area in the province, the biggest irrigation area being adjacent to it, and you can see all the mountains and the inhabited areas.

This is the upper end of the Fraser valley just about Chilliwack, and here is the end of the cultivated area. This picture illustrates the industrial area in the Kootenays. This is the Kootenay river, and you can see over to Castlegar at this point, and you are looking up the trench at that point. So you can see again how little of the area of the country is occupied. This is the industrial region. This is a hive of activity.

This is Revelstoke, and we are looking down at Arrowhead at this point, and you can see some flooded land to the south of Revelstoke. Here is a tremendous range of mountains in the background, and behind us is the Glacier national park, and then your Rocky Mountains.

This is the rocky mountain trench looking towards McBride. This is the route of the Canadian National Railways, and it has been in there for about 50 years, yet even today there is practically no land throughout the area which is what we would ordinarily call occupied.

I will leave these photographs with the committee so that you may refer to them if you wish to do so.

On account of our very rugged topography and our relatively small population—and that population being almost entirely in the valleys—access to almost the total area of the province is difficult, as a result of which our stream flow and meteorology records are very poor.

We recently have discussed one problem with the meteorological services. In this corner of British Columbia—in a region approximately this size—there is not a single continuous meteorological station in the whole area. It consists of an area of 27,000 square miles, which is approximately the same size as the province of New Brunswick—and we have not a single station in that area.

These are very real things because, when we come to try to define a problem and write a report upon it, such as in the case of the Fraser river board, we have to spend almost ten years in acquiring basic data before we can discuss a matter of flooding, water power, erosion and other aspects of it.

It seems important to us, when dealing with water, that a very active program be advanced, in order to obtain this information as far in the future as it is economically possible to do so. In many cases, we recognize that it would be difficult to demonstrate an economic worth in some of these matters. However, notwithstanding that, we will always be behind in our information, no matter how hard we try.

Also, I wish to make representation to this committee that when meteorological or hydrological data is put together and published, that it be edited carefully and corrected, so it may be used afterwards without having to re-scrutinize the material to find out how accurate or usable it is. Our remarks primarily are directed toward the hydrological people rather than the meteorological people. As material has been published over the years, there has been a great deal of discrepancy in the information. There is a lack of interpretive material and, unless the people who use the material published are quite skilful hydrologists, they will have great difficulty and find themselves involved in quite a few errors in connection with the present form of material that is

put out. I am not going to belabour that point too much, but I think the water resources people, who are here, might even agree with me. I would not say they disagree with me in this matter.

The CHAIRMAN: Mr. Paget, I may say, for your benefit, it has been brought rather forcibly to our attention by previous witnesses, that we are short of meteorological data from a water resources point of view particularly, in most of Canada.

Mr. PAGET: In connection with any record, we are asking specifically to have a much better network established. The province of British Columbia, largely because of the deficiency of met information, undertakes and carries forward a vigorous program of snow surveys, in which we measure the accumulated snows throughout the winter time at high elevations, in order to forecast, with a great degree of reliability, the total outflow that will occur during the summer months. I brought a couple of our last bulletins with me; I will leave them with you, to show samples of the type of work we do. We do this work wholly, without support from any other agency. However, in doing this work, we can, with a fair degree of accuracy, forecast the total volume of water flow, but we are not able to predict with any accuracy the maximum flows that may occur, or when these maximum flows are liable to occur. We need a great deal of assistance from the met people, in this regard.

We have made a recommendation in the Fraser river board report that a flood warning system should be put into effect in the Fraser valley and, in our report, recognizing that to do this and make it effective, we would need a very substantial increase in the number of high level stations for recording weather. I do not know how effective this would be. I could not predict it without having some experience and some history in doing the work. Without the basic data, we even cannot acquire experience in working on this problem. I do not wish to hold up the United States as an example of this, but in the case of the Columbia river, and agencies at work on the Columbia river to predict flood crests—and the corps of engineers do the predictions—there are hundreds working on this problem, and hundreds of recording stations, not the least of which are about 30 stations which we operate in Canada on behalf of the Americans, for flood control on the Columbia. So, we are not able to operate a single flood control program in Canada by ourselves, because of lack of met data. In that regard, this is rather strange.

I rather think, Mr. Chairman, that I have generally covered my paper, to some degree. However, I would like to mention one point—and I think I will read this; it is on page 9 of the brief.

Surface water

> The agencies presently involved directly or indirectly in the collection and processing of data are (1) water rights branch, province of British Columbia.

—and that is exactly right, for those who do not come from British Columbia. We do not look at water much differently than we do land and, consequently, the province takes a very strong position with reference to water matters, and the program that we have in hand on water matters is quite sophisticated. We are quite alert to the several problems we have, such as flooding, erosion, irrigation, general water supply, and so on, but we are still inhibited from arriving at easy solutions in the case of many things upon which we would like to work, because of the fundamental lack of basic data.

(2) Water resources branch, Department of Northern Affairs and National Resources.

This was an arrangement made between the water rights branch and the water resources branch during the depression, at which time the province agreed to turn over their program of water measurements to the federal government so that the federal agency could keep their staff of engineers engaged at work—and we have not carried on this program since. I sometimes think we will have to reconsider that.

(3) Meteorological service, Department of Transport.

and,

(4) The federal Department of Agriculture.

A great deal of experimental work, in reference to water, is carried out by the Department of Agriculture, such as irrigation, and problems of that kind.

(5) Additional agencies.

We have a multitude of agencies which, for their own particular use, do stream gauging, and acquire water records. The Department of Fisheries is very active in a stream gauging program, and the power companies also do quite a bit of work in this field. Irrigation districts and some municipalities do similar work. The Department of Public Works carries out investigative programs, with relation to navigation. I do not disagree with this multitude of agencies, but I do disagree with the lack of publication of the results of their investigations. Their investigations, in most cases, are all carried out for different purposes. I feel they should put their material in a place where everybody else can make use of it. That is the most serious disagreement I have in connection with that.

Mr. Chairman, I think that is all I can say on this subject, at the present time.

Mr. FLEMING (*Okanagan-Revelstoke*): Just on this point, do I understand, that although there is this tremendous diversification of organizations and government departments active in this field of collecting data, which will be extremely valuable to you, there is no authority of any kind that publishes results or coordinates this in one place, where it can be easily obtained and used. Is it not true that, very often, you find you have to go to a great many different sources for information, because there is no central point where all this is collected?

Mr. PAGET: I think that is right. However, it is not wholly right, as every statement is somewhat inclined to be an over-statement. I recommend, in my brief, that some central agency should search out this material, analyze it, and place it together in some form so that the people who want the information can readily obtain it. I think the easiest way is to quote an example. We have had problems with Cowichan lake, and have installed a weir at the outlet, to maintain summer flows at a high level, for a pulp mill, and in order to maintain better flows for the fisheries people, and an ultimate reserve available for agricultural use. This did not work out 100 per cent, because we did not have too good a type of information on the hydrology of the area. When we went to get a better analysis of this made, we found out there was no lake elevation gauges that had been read by the federal service—or they had shifted the gauges around. We ended up by locating a forest ranger who had kept his own informal records for a good number of years. We obtained his information, which was the best available in connection with Cowichan lake—and, as far as I know, it still is. These are the things that people, who are truly interested in the hydrology of an area, should be searching out, publishing it, and showing the limitation of values

of this material. However, sometimes it will not be too valuable. As an example, in the case of the Fraser river, it was most difficult to find out the elevation of the 1894 flood. Here and there, somebody drove a spike into a section house, marked it on a rock or foundation, or something of this kind, and through this, we determine where the 1894 flood came. These are the things that should be searched out and recorded for posterity because, while we have been able to find some of these during the last 10 years, I am sure that within the next 25 years it will be very difficult to ascertain.

Mr. FLEMING (*Okanagan-Revelstoke*): In connection with an area, like the Vernon area irrigation watershed, when they make their snow surveys in the spring to predict the water supply they are likely to have available for the coming season, do they automatically make that data available to your water rights branch—or, do you call on them, if you require it?

Mr. PAGET: That is our snow survey course, and they read it, as a cooperative agency, for us. We make an assessment of the outflow for them, and we publish all the material in our annual snow bulletin.

Mr. FLEMING (*Okanagan-Revelstoke*): Is that practised throughout all the irrigation districts in British Columbia?

Mr. PAGET: Wherever we have an irrigation district that has a problem, and are willing to cooperate, we ask for their cooperation. Sometimes we have to read these courses ourselves, as we do not get the cooperation.

Mr. PAYNE: Is it not true then that the problem is one of liaison between the two levels of government, as you find difficulty in searching out the sources of information? Is there no basic contact you can use, by coming to Ottawa?

Mr. PAGET: Oh yes. The liaison between ourselves and the water resources branch of the federal government is extremely good. I suppose we have the best liaison between the two agencies in the world. It is a matter of effort—the responsibility of effort to acquire this information and publish it.

My criticism, if any, in this matter, is not in the liaison; it is the production and use of the material afterwards. Undoubtedly, there can be some criticism upon myself. I am not trying to shift the whole blame, by any means, on the federal agency. If we had a larger staff, we could go much deeper into this problem of stream measurements, and acquire the data, as a separate agency—although, fundamentally, I do not believe we should do it. We pay a grant to the federal government for their participation in this program.

The CHAIRMAN: Has anyone else any questions?

Mr. PAYNE: There is one point, Mr. Chairman, on which I would like to ask a question. It has to do with certain basic data that came from the federal Department of Public Works—and I am not too clear on it.

For what type of information do you go to the federal Department of Public Works?

Mr. PAGET: Well, the federal Department of Public Works have acquired a lot of information on water elevations, and they have done quite a lot of bathymetric surveys. In that regard, they should be as expert as anybody in dealing with the problem of navigation in the lower Fraser river. They should have the information concerning water depths, channels, and all that type of information concerning navigable programs—water elevations, where they have docks and harbour facilities, and so on.

Mr. PAYNE: These are exclusively under the Department of Transport?

Mr. PAGET: That may be. However, I am not bright enough to differentiate between the Department of Transport and the Department of Public Works.

Mr. PAYNE: That is the point we are trying to get around. Then, this refers, basically, to tidal waters and major navigable channels.

Mr. PAGET: That is true. They have done navigable studies in reaches that are not navigable—but, generally, it is in that area of which I am speaking. We have tidal problems along with our river problems.

As you probably appreciate, some of our worst flooding conditions in the lower Fraser do occur in the winter time when we have adverse tides and heavy rainstorms. It is not altogether a matter of river flows. We have to be alert to the tidal effect, in many cases. This happens in the Comox-Courtenay area, because of tidal conditions and heavy rains.

Mr. PAYNE: In regard to the interior rivers—and I have in mind, the Columbia, Peace, Parsnip and the Finlay—how extensive are your studies, and how much basic information have you available in respect to flows, and so on?

Mr. PAGET: We will work from the north to the south. It might be easier that way.

In the case of the Peace—as we are not, fundamentally, too interested in the flows of the Finlay and Parsnip, because we are planning one major dam to create a reservoir in the neighbourhood of Hudson Hope—we have something like 42 years of records, which were interpreted for 13 years during which the federal government did not take any records. However, by correlation, we have attempted to re-create the records of the 13 years, and we have now a fairly realistic appraisal of the total volume of water that we can expect in the Peace river system. However, we are not too sure. This is a problem with which we have been spending a great deal of time recently. We are not quite sure what the maximum floods might be in the Peace river, because of the lack of data. Although this is not in my field, from an engineering and curiosity point of view, we reflected on this condition—through the Slave and into the Mackenzie, and while we are deficient in data in connection with the Peace, when we get to the Mackenzie, there is no data whatsoever—and this is one of the major rivers in Canada. It is practically without any data at all. After we move into the Columbia, we have quite a long history of record concerning the lower Columbia river. We have something over 40 years of record at Trail, and we are quite confident as to the total volume of flows from the Columbia in Canada—confident within the percentage of error that is liable to be in these things. This is still the case in connection with the Kootenay. The West Kootenay have kept close records. However, in the case of some of the other streams, our information is very poor. As we get further up the Columbia, our records become poorer and poorer, until we arrive at the region above Revelstoke and Canoe embankment. There is very little pre-record in that area.

We are out in the field at the present time. The water rights branch is studying the Liard river in British Columbia, as that river is almost completely without information. We are doing this in cooperation with the federal government. We have paid for half the cost of a station on the Liard, and are now measuring the river. The same applies to the Stikine. Only in the last three years, at great cost, have we established some stations on the Stikine and the Iskut.

Mr. PAYNE: Is that the automatic type?

Mr. PAGET: It would have to be the automatic type, with the observer flying in periodically.

I think these photographs illustrate the difficulties in maintaining a constant service, without considerable expense. It is a fundamental problem

which British Columbia has. I do not know if it occurs elsewhere in Canada, but well over 90 per cent of our land area is unoccupied, much in the northern regions and high altitudes, which makes it difficult to do these things.

Mr. FLEMING (*Okanagan-Revelstoke*): You have indicated that you feel there should be an increase of high elevation meteorological stations in order to collect data so that your branch could compile these high elevation snow surveys. Can you see any merit in the possibility that there might be a co-operative scheme there between the snow surveys and the meteorological data surveys? Might there not be some kind of combination in order to secure both types of information on a cooperative basis, between the province and the federal authority?

Is their branch adaptable to a cooperative scheme of that kind?

Mr. PAGET: I do not think so. They have this same problem in the United States, and have worked at it with a great deal of intensity. The weather bureau there are running their affairs, distinct from the collecting of snow data. The snow data collection, and the way it is analyzed, is, essentially, an engineering approach, whereas the approach of the met people is, largely, a statistical one. We too, only intermittently sample courses. There are a few key ones we sample from January 1 to June 1, but there is only one day in the year when all are sampled—and that is April 1. April 1 is what we consider our key time, and we sample all on that date. Some courses get sampled six or eight times a year, whereas other courses are sampled only once a year. Obviously, you need a continuous flow of met data, and it would be much more continuous than we would be able to give.

Mr. FLEMING (*Okanagan-Revelstoke*): From the nature of the country, the most probable type of station which would be established for meteorological data would be an automatic station that was taking readings electronically, I suppose, because the places where you want the stations would be almost impossible to man on a 12-month basis. Is that correct?

Mr. PAGET: I cannot answer that, because it is a matter of economics. There is a good deal of information now concerning this automatic recording station. I have seen some papers concerning them, and some of the experimental equipment. They are quite expensive, and they still have some bugs in them. However, there is quite a maintenance problem, even with your almost automatic recording stations, and they are quite expensive, because you have to set up the radio network to relate the things to a central point. I am not going to say it is as easy as that.

Mr. PAYNE: If I may, Mr. Chairman, I would like to refer back to the evidence on page 41, which has to do with matters relating to the British Columbia and federal authority. The evidence reads as follows:

> Mr. PAYNE: To return to the Rocky Mountain trench and Peace river, has the branch been called upon by the province of British Columbia, any agency or company, for an accelerated program, indicating their requirements and their need for more information?
>
> Mr. McLEOD: As far as I am aware, not by the province of British Columbia. The consultant firm for the company has requested some additional information downstream on the Peace and Athabaska rivers in Alberta.
>
> Mr. PAYNE: Have the developing engineers concerned indicated in any way that they are working with insufficient information at the present time?
>
> Mr. McLEOD: No, not to my knowledge.

Now, this had me worried at that time; it has me worried still, and I wondered if the witness would care to say anything further in connection with that brief exchange or not. I am sure that I and the other members of the committee would appreciate it very much if Mr. Paget felt free to discuss this in an open way, because I think it is indicative of the things that you suggest should be done in this brief.

Mr. PAGET: I think, Mr. Chairman, that Mr. McLeod gave you honest answers from the exact situation, because this matter of stream records is a fait accompli. When you go around to make a design on major water development, you can only use existing data. There is no use in saying—unless you are intending to do something ten years from now—that you want 10 years more experience, because you would have to wait ten years before it is all in hand. If you want to do something with this data, you are not going to ask for more; you are going to take what you have, and use it. In the case of the Peace, I do not know how probable the results were, but at least they were comforting. We did correlation studies in connection with the Athabaska, Fraser, Columbia and Bridge rivers. This is making an assumption that I do not think is valid—that the climate of British Columbia is uniform. If we had met stations in this Peace river region, and had met stations in these other regions, recording all that time, I think the comparisons might have been valid—or, at least, we would have known how valid they were; but all we had were stream flow records, and no met data. It might well tell us whether or not we are right, however, I think, in connection with major rivers, the records we have are reasonably accurate—and we stay on the conservative side when giving predictions.

I would like to stress the point that in the case of the Columbia, Fraser or Peace rivers, the investments consequent to their development, run to many hundreds of millions of dollars, and a percentage of 5 per cent or more in error on the prediction of power could have a distressing affect on the economics of the scheme.

Mr. STEARNS: During the last 40 years, have you noticed any distinct warming up of the climate in British Columbia?

Mr. PAGET: I am not a meteorological person, and this problem has been thrashed out by many people. However, I would say there is no real evidence to indicate that.

There is a recession of glaciers in most regions of the province—but that has been going on for something like 10,000 or 20,000 years, and I do not know whether we can say that there is a reversible trend or not. There are some glaciers in the northwest corner of the province that are increasing in volume—and I do not know what that means, climate-wise. I do not think you can take a trend within a period of 40 years; you would have to get records over 200 years before you could do that.

Mr. STEARNS: Therefore, your summer stream flow has not increased considerably in the last 40 years?

Mr. PAGET: If anything, it might be showing a tendency to decrease.

Mr. STEARNS: I would have thought, if it was getting warmer, that there would be an increase.

Mr. PAGET: There is the question of the migration of the storm tract northward. Our interior regions are now arid, or semi-arid. There actually are desert conditions in the southern interior valleys, and any movement northward of the storm tract would leave these regions more arid than today—and we would not expect to do any better.

In that connection, the problem has been looked at with a good deal of intensity, to find out if there is any cyclic indications of weather. Some

think cycles of sun spots have an influence on the weather. The year, 1948, was one of greatest summer floods, but statistically fell into one of these dry years. So, I do not know. I am not buying any of this at the present time, and I will not live long enough to analyze the data to find out how you should use it.

Mr. STEARNS: None of us will.

Mr. PAGET: We have very arid regions in the province during the summer time, even in the coastal region. The whole country is very dry. The only water we have is our snow melt water. We are storing our water on mountain tops in the form of unmelted snow, which comes down to us during the period we need it most, and of course, that increases the problem of floods. We have an accumulation of snow and, in the normal course of events, this snow melts and runs off to the sea without too much distress, but if we run into a time of continental highs—that is, climate-wise—which blankets the whole province, we get an accelerated snow melt, which happened in 1948, with the result that there was great flooding. Normally, we have a period of about six days between storms coming from the gulf of Alaska into the province, and the weather will warm up. This condition will last for about six days. Then we get another storm. This throttles our snow melt. The year 1948 was one illustration where this condition did not exist. We did not get the cold storms from the gulf of Alaska. We had high temperatures, mixed with rain, and a heavy accumulation of snow in the mountains. Consequently, we had a major flood. That is the reason we need this data, to correlate it with existing information of snow accumulation.

Mr. HICKS: Mr. Chairman, I have one or two questions I wanted to ask in connection with Hatzic lake. I do not know under whose jurisdiction this problem comes. I understand that before the 1948 flood, all the area around there was drained into Hatzic lake, and it went from there out under the highway and under the railroad, into the Fraser river—and things were satisfactory. Then, in 1948, when the flood came, it took about five acres of land off a farm on the south side of the railway. It took the whole thing out, and there was a large deposit of silt. Now that things are put back into shape, the water does not get out of there the way it used to. In fact, they tell me that the old runway is filled up and should be dredged out. They say that the openings under the railway track are not large enough to carry the water, and some of the farmers there are wanting to know what can be done about it.

I believe also—and Dr. Whitmore can verify this—that there used to be salmon come up in there, and now they claim they do not.

Whose responsibility is that, or can anything be done to rectify it?

Mr. PAGET: The responsibility is not with the department of lands and forests. It would possibly lie in the Department of Agriculture. We can shift the buck around too. The dyking inspector is with the Department of Agriculture, and the Hatzic drainage and dyking,—

Mr. STEARNS: That concerns Mr. Meighen.

Mr. PAGET: Yes. It would fall in that area.

I think the real problem there is this. Before the dykes broke at Hatzic, the dykes consisted largely of the C.P.R. track, and when these were constructed they would not permit these of their right-of-way for dyking purposes, and the relocation of drainage facilities through the dykes caused relocation of the outlet channels there. I do not think the condition is extremely adverse. We have not had any real complaints there, except for some people who said we should keep the water up because the dust problem is bad.

Mr. HICKS: That is another thing. When the water gets down, and there is an accumulation of silt, it dries out, and blows into the ladies' front rooms and so on. They complain about that.

Mr. PAGET: This is not a general problem it is a very particular one. It is one that I think should be discussed with the local authorities. If they really want to correct this condition, it will cost them money—and probably that is their problem. As is generally the case, they want somebody else to spend the money to correct it. However, it is their problem.

Mr. FLEMING (*Okanagan-Revelstoke*): Mr. Paget, as you probably realize, one of the great Canadian myths is that British Columbia, east of the Rockies, is a land of continuous rain. In order to give emphasis as to why it is felt in British Columbia that this additional collection of data is so essential, will you describe those areas which you say are arid? Will you show the areas where water has to be carried to the land, because of insufficient rainfall, in order to make it practically for agricultural or community use?

Mr. PAGET: Yes.

So far as British Columbia is concerned, I can say that the whole area is summer dry. There is hardly a place in British Columbia that does not need some assistance at some time of the year. Irrigation is actively practised on Vancouver island; the lower part of the Fraser valley adjacent to Vancouver; the Okanagan, and the whole interior. Because of the precipitous nature of the country, when the snow melts, the water pretty well all runs away and there is not enough residual water, in the form of springs, to adequately maintain the stream flow during the summer months.

Certainly, we are worse off than you suspect, because our ground water reservoirs are small and, if they are used to a large extent, perhaps would not be replenished. We have not the wide topography such as in the prairie provinces, where the ground water supply is dependable. This region is small, because of the narrow sloping valleys. Our dry areas are indicated here on the map in light green. It is a high plateau, and cut up by high mountain ranges. Osagoos, Ahar Penticton, Kelowna, Vernon, and Armstrong are all in the Okanagan region. The range of precipitation there is from eight inches, in the southern part, to perhaps twenty inches around Armstrong. Then we go into the Thompson valley, from Lytton, through Ashcroft, and on up to Kamloops. Down around Ashcroft our precipitation is about eight inches per annum. That is desert precipitation. We can only measure in the valley, because we have not met stations on the mountains. When we get further up the precipitation is probably around twenty inches. Then there is the whole of the Caribou region, going up through Clinton, Williams lake and Quesnel. It is dry and arid, and possibly in the order of 12 or 14 inches of precipitation. By the time you get up to Prince George, you run into a region where there is storm activity in the summer time. This area around Prince George is the least summer dry of any part. The lower Fraser valley and the east side of Vancouver are almost as bad. We have the feeling that Victoria is a wet place. The average rainfall in Victoria is 22 inches or 24 inches, and occurs during the winter months. Therefore, it is very dry around there in the summer time. There is approximately the same amount of rainfall in areas south of Vancouver. They practise irrigation quite extensively in this region to assure themselves of a summer crop. Then, when you get into Vancouver, you have twice as much rainfall as Victoria. The north shore has twice as much as Vancouver, and it gets into distressing figures when you move into the mountains. The East Kootenay is also very dry, and they practise irrigation, as they do along the Kootenay, and the Arrow lakes. Practically all the interior regions, other than in the Peace river block in British Columbia, are subject to reclamation of some kind—drainage, dyking and irrigation. This involves a great expense.

Have I answered your question satisfactorily?

Mr. FLEMING (*Okanagan-Revelstoke*): Yes.

The CHAIRMAN: If there are no further questions for Mr. Paget, I would like to thank him very much.

I believe Mr. Côté would like to make a comment.

Mr. E. A. CÔTÉ (*Assistant Deputy Minister, Department of Northern Affairs and National Resources*): Mr. Chairman, on the general question of gauging stations, I do not want to dispute the fact of geography, so far as British Columbia is concerned, or detract from the opinions expressed by Mr. Paget. However, from the committee's viewpoint, in so far as the federal gauging stations are concerned, those stations which are maintained either by the water resources branch alone or, in cooperation with British Columbia, there are at present something of the order of 450 water gauging stations maintained in British Columbia, on which records are published annually by the water resources branch. This is out of a total of 1,364 gauges as of March 31, 1960. This shows an increase of 100 gauges, roughly, over the previous fiscal year, and 50 over the year 1957-58. There was, back in the 1930's, quite a drop, as Mr. Paget indicated. In the 1930's there were 500 stations only, compared with those in 1924-25, totalling 757, throughout Canada.

As I say, I do not wish to detract in any way from what Mr. Paget has said. There is a need for an increased number of gauging stations. However, I thought the committee would want to have some manner of proportion as to what gauging stations existed on which records are being published by the water resources branch. Then, there are your own records, and private records which, themselves, are not published, and on which something might well be done.

The CHAIRMAN: These gauging stations, and their records, lose their value if they lose continuity.

Mr. CÔTÉ: Yes. We hope we shall be able to maintain the number of gauging stations and, as experience is acquired, in cases where, by agreement with a province, it is found that we could drop a gauging station, we hope to establish that as a matter of policy, and we are doing that typical analysis in an area, which still gives us at least a touchstone to the stream flow of a given area.

Mr. FLEMING (*Okanagan-Revelstoke*): Did I understand you to say there are 450 as compared to 500 in 1935?

Mr. CÔTÉ: No. There are 449 in British Columbia now. There were 500 in the total of Canada in 1934. In the total of Canada there are now 1,364—500 as against 1,364.

Mr. FLEMING (*Okanagan-Revelstoke*): It is still inadequate?

Mr. CÔTÉ: Yes.

Mr. PAGET: We have many thousands of miles of streams, and I would like to know how many miles of streams we have in comparison to the rest of Canada?

Mr. CÔTÉ: I would put it this way: there is no doubt at all that Quebec and British Columbia are the most important provinces in Canada from the hydraulic viewpoint.

Mr. STEARNS: How many stations are there in Quebec at the present time?

Mr. CÔTÉ: Have you that figure, Mr. McLeod?

Mr. J. D. MCLEOD (*Chief Engineer, Operations Division, Water Resources Branch, Department of Northern Affairs and National Resources*): I do not have the exact figure, but I think it is about 190 or so.

Mr. CÔTÉ: As of 1959, the figure is 179. However, it has gone up, so probably, it is about 190.

The CHAIRMAN: Gentlemen, we have with us Mr. Whitmore, the director of the Pacific area. He is with the federal Department of Fisheries, and makes his headquarters at Vancouver, B.C.

Some of the members were interested in having a representative from the Department of Fisheries discuss with us their participation in the Fraser river studies.

Mr. Whitmore is a member of the Fraser river board. We have asked him to come here and tell us about the participation of the Department of Fisheries in this work.

Mr. PAYNE: Before you call on Mr. Whitmore, Mr. Chairman, I wonder if it would be possible to consider reconvening after Orders of the Day.

It does seem to me that this is a very important subject and, although it is not going to take an endless period to discuss, certainly twenty minutes would not be a sufficient length of time. It will be such a thin capsule, that it will mean little to the committee.

Mr. KINDT: There is a caucus meeting at 3 o'clock.

Mr. PAYNE: My suggestion is that we could reconvene perhaps at 12 o'clock, and go through to one o'clock.

The CHAIRMAN: Mr. Whitmore, would you be able to come back a little while later?

I wonder if Mr. Whitmore could proceed to give us an outline of his brief and then, if more time is required, we can arrange to meet at a later hour.

Mr. A. J. WHITMORE (*Director, Pacific area, Department of Fisheries*): Mr. Chairman and members of the committee; I really am following on from some evidence given by Mr. Patterson of the Water Resources Branch on May 3.

In the interest of covering as much ground as possible in minimum time, I have put some notes down, and would like to read them into the record.

1. Mr. T. M. Patterson from the water resources branch of the Department of Northern Affairs and National Resources and I from the Department of Fisheries are presently the two federal government representatives on the Fraser river board. Mr. Patterson is presently chairman and his statement to this committee on May 3 reviews the responsibilities and work of the board and of the studies presently in hand relating to flood control and a partial hydro electric power development on the Fraser. These studies include the questions of possible effect on navigation, fisheries, silting, erosion, etc. I would like if I may be permitted to review the fisheries resource aspect of these studies.

2. Firstly, I should like to refer to paragraphs 4 and 9 of the terms of reference or agreement between the federal and provincial governments dated July 16, 1959 for continuance of the board.

Paragraph 4 in part reads—

> Canada and British Columbia share equally the cost of the government investigations and report, providing on an equal basis funds necessary for the general expenses of the board and for work authorized by the board, and carried out especially in the interest of its investigations, as distinct from work normally carried out by civil servants for their various departments cooperating with the board. The cost of the board's operations should not exceed the amount forecast on page 171 of the preliminary report on the Fraser river basin dated June 1958 unless the governments otherwise agree.

Also to Paragraph 9—

In conducting its investigations and performing its duties under this reference, the board may utilize the services of engineers, geologists, specialists and other employees of the public services of Canada and British Columbia. It may call on government departments to conduct studies and provide information which may require the formation of departmental or inter-departmental committees. The board shall make all possible use of existing reports, information, and technical data and also any that may become available during the course of its investigations, in order to avoid unnecessary expense and duplication of effort.

3. The original board set up early in 1949 known as the dominion-provincial board, Fraser river basin comprised 10 members—5 from the province and 5 from the dominion. Of these ten members, 2 were identified with fisheries, i.e. the then deputy minister of Fisheries for the province of British Columbia and the chief supervisor of fisheries for British Columbia of the federal Department of Fisheries. When the board's membership was reduced in the later agreements, the federal Fisheries representative only was continued. He has been the same person throughout, i.e myself and inasmuch as during that time I have been one of the Canadian members of the international Pacific salmon fisheries commission which is primarily concerned with the Fraser sockeye and pink salmon, provision was thus made to assure that the interest of that commission in so far as the board's assignment was concerned was kept before the board.

4. Paragraph 3 of the agreement required each member to name an alternate to act in his absence. My alternate throughout has been Mr. Charles H. Clay of Vancouver. He has held the post of chief engineer, Pacific area, for the Department of Fisheries since 1949, is a graduate in engineering from U.B.C., prior to departmental service was resident engineer for the international Pacific salmon fisheries commission for the construction of Hell's Gate fishways and other major fishway installations on the Fraser.

Fisheries representation in the work of the Fraser river board has also included continuing service incidental to regular departmental duties by Mr. L. Edgeworth, a senior engineer of the department, under Mr. Clay, as a member of board's technical advisory group. Chief biologist of the department in British Columbia has also assisted in an advisory capacity from time to time. The director and chief engineer of the international Pacific salmon fisheries commission as well as other technical personnel from the commission have contributed valuable advice and assistance through the fisheries representation on the Board. Biological and engineering research by the salmon commission on the many phases of the life history and habits of the Fraser sockeye has extended over a continuing period of 23 years and hence this source of experience and knowledge was of great value in the over-all fisheries problems. Similarly full use has been made of extensive research by the fisheries research board of Canada on Pacific salmon generally.

5. Participation up to this year by fisheries personnel in the boards studies and work has generally followed the directive of the board for utilization of existing government services. Special fisheries studies are now required in connection with partial plan system "A" for flood control and power development. Ten dams are contemplated and the need for special funds to acquire further biological data was indicated in the preliminary report. These studies are now proceeding and an experienced fisheries biologist and a technician have been employed. They will work for the board under Department of Fisheries direction and supervision and will be additional to such advice and assistance Fisheries Department and salmon commission staff resources might normally be able to furnish.

6. Federal Fisheries representation on the Fraser board undoubtedly had in mind two federal Statutes:

(1) The Fisheries Act, Chapter 119, which implements federal responsibilities under the B.N.A. Act for the "regulation of the sea-coast and inland fisheries".

(2) The Pacific Salmon Fisheries Convention Act implementing convention between Canada and the United States for the protection, preservation and extension of the sockeye salmon fisheries in the Fraser river system signed at Washington in May 1930 and a protocol thereto signed at Ottawa on 28th December 1956.

Many responsibilities and duties are prescribed for the preservation and maintenance of the fisheries of Canada by the Fisheries Act—and particularly for determinations in the public interest in regard thereto by the Minister of Fisheries in respect to the accessibility of streams for fish, the provision of necessary aids and protection for fish in streams in upstream and downstream migration and for the protection of spawning grounds—see sections 22, 25, 28, 30, 33.

The Pacific Salmon Fisheries Convention Act implements Canada's obligation under article X to make effective the provisions of the Fraser river sockeye convention between Canada and the United States and subsequent protocol of 1956 in respect to pink salmon. The phraseology of the convention in respect to sockeye reads "The protection, preservation and extension" of the sockeye salmon fisheries of the Fraser river system.

* * * *

7. Both the interim and preliminary reports of the Fraser river board have given comprehensive coverage to the question of fisheries in relation to its general assignment pertaining to flood control and power. Chapter 6—pages 141 to 163 of the 1958 report is headed "effects on other interests of river regulation for flood control and hydro power" and states that "the Fraser river salmon fishing is the principal interest that would be affected". Fisheries is dealt with commencing on page 142. The dominant sentences of each of the first three paragraphs are:

(1) The Fraser River is now the largest salmon producing river system in North America.

(2) The commercial fishing based on the spawning migration of Fraser river salmon has developed into a multi-million dollar protein food industry annually producing raw wealth on a renewable basis.

(3) From a financial point of view salmon dominates the British Columbia fishery.

The coverage given to the Fraser fishery includes:

(*a*) several sections reviewing values of runs, international participation, increase potential stemming from Hell's Gate fishway construction and rehabilitation program under scientific management, and Indian fishery (traditional personal consumption) factor.

(*b*) Characteristics of species and their migrations.

(*c*) Spawning distribution.

(*d*) Restoration of depleted runs.

(*e*) The fishing industry.

(*f*) Effects of dams on fishing.

(*g*) Upstream migration.

(*h*) Downstream migration.

(*i*) Spawning and incubation.

(*j*) Rearing of salmon.

(*k*) Biological and engineering research on the fisheries problems created by multiple water use projects.

(*l*) Conclusions regarding the effects of dams on the fishing.

A table is given showing the distribution and timing of the salmon migrations and the estimated maximum daily adult migration at potential dam sites. This fisheries section is well referenced as to authorities and technical reports and data for statements and conclusions alluded to. Associated with the conclusions regarding the effects of dams on the fishery is the listing of potential dam sites into two groupings.

(1) Those which would have no serious over-all effects on the Fraser river fishing (page 152 of report)

(2) Those which might be developed for flood control and under certain conditions, power, providing fisheries are fully considered in the planning stages (page 153).

In his comprehensive review, Mr. Patterson referred to the consideration given by the board to three alternative systems in its power studies and how each involved a number of dams which might cause serious delay to the migration of anadromous fish and damage to the salmon runs. Also that the board recognized the importance of the Fraser river salmon runs to the economy of British Columbia and the serious delays which would result to flood protection measures if a solution to the fisheries problem had to be awaited. It decided to examine the possibilities of achieving flood control in conjunction with a partial power system using dam sites located on river reaches where they would be least objectionable to the fishery interest and in which the following four factors would be satisfied:

(1) To provide flood control.

(2) To be an integral part of a major power system.

(3) To be compatible with fisheries.

(4) To be economically self-supporting through power production.

One partial system—referred to as System "A" was evolved which gave promise of fulfilling these four principles. This contemplated eleven dams i.e., 5 on the Clearwater, 3 on the Cariboo, one on the McGregor, one on the main stem of the Fraser at Olsson Creek site above Prince George and possibly one—a low dam—at the outlet of Stuart lake. The latter would not be needed if raising of the dykes in the lower valley was undertaken. Several of the ten sites involve dams where fisheries studies are required complementary to the palnning of the dams to assure adequate fish protection.

As stated by Mr. Patterson in extending the life of the board last year the two government's accepted the board's recommendation to establish the physical feasibility of projects in system "A" and an active program of foundations drilling and mapping is underway as well the additional biological studies relating to the fisheries interest. The latter has particular regard to recommendation No. 5 by the board:

> That a program of surveys of the fisheries interests related to the partial developments be initiated with a view to determining the facilities needed and their cost, beginning with system "A".

This concludes my presentation.

The CHAIRMAN: We can have this room again at 2.30. It should not take too long to conclude Mr. Whitmore's evidence. Also we have the items in the estimates to deal with. I do not think they will take too long. I would like to deal with them this afternoon if possible. Can some of the members come back? Somebody mentioned they had a caucus meeting at 3 o'clock. Can you come back at 2.30? Can anybody come back at 2.30? We will have to dig up some more members of this committee in order to conclude our business. Will you see if you can find some of your colleagues and ask them to attend.

We will reconvene at 2.30 and Mr. Whitmore can conclude his evidence. I know there are some questions which you would like to ask of Mr. Whitmore. Also we will deal with the items in the estimates as there are only a few of them.

## AFTERNOON SESSION

TUESDAY, June 14, 1960.

The CHAIRMAN: Gentlemen, we have a quorum, Mr. Whitmore conducted his written presentation, and I am sure he will be glad to try to answer any questions you may care to ask him.

Mr. PAYNE: I was wondering if Mr. Whitmore would care to discuss in any detail the matter surrounding system A which Mr. Patterson discussed on May 3, and subsequently on May 24? And regarding that system, you will remember that there was some question having to do with the fisheries problem that would be encountered if they were brought into being.

Mr. Patterson felt that many of these questions were of a technical nature, and I believe that was primarily why recently personnel from the Department of Fisheries had been combined to undertake to certain biological studies with respect to this matter.

Mr. WHITMORE: Mr. Chairman, I think the report of the Fraser river board of 1958 deals generally with the fisheries problem associated with system A.

Several of the sites or dams which might provide flood control as well as some degree of power—would not have any effect whatever on fisheries being on rivers presently not containing runs. There are three or four sites however where there are runs.

Perhaps I might refer to the map. The main stem site is at Olsen creek, and there are engineering studies still going on to decide whether this is a suitable site or not. There are two or three runs of salmon that pass Olsen creek to upper spawning grounds, one to where the spring salmon run spawns at Tete Jaune; and a run of sockeye to the Bowron Lake system.

This is of interest to the International Pacific Salmon Fisheries Commission because it is of the sockeye variety. Another dam referred to is at the Stuart site. This site is provided as a possible alternative to raising dykes in the lower Fraser valley and involves quite a large early run of sockeye. The dam would be a low level one. The consideration of getting the fish over that dam in upstream migration would not be serious, nor in the matter of downstream movement of the young salmon.

However our biologists tell us that a dam there would raise the level of Stuart lake from ten to 20 feet or to whatever height required, which might badly alter the general environment of the lake for feeding and rearing purposes of the young sockeye after dropping down from the upper tributaries of the Stuart system, for their first year of life.

There are considerations which have to be especially looked into from a biological standpoint; and the two specialists presently employed by the board

with board funds are working on several of these. Normally of course it is a fisheries department responsibility to maintain a general assessment of the spawning population and other conditions throughout the system, but such an assessment has to do with conditions as they have traditionally existed.

If some new condition is imposed, it immediately brings into being the need for some study as to what the new conditions are, and what effect they may have. I have been associated with the salmon commission for many years and we have very competent biological advice from our scientific staff. They are forever impressing upon us the sensitive nature of salmon in relation to environment and that any alternation one way or another may have serious effect on the whole nature of the run.

Mr. PAYNE: Is there anything in the way of statistics, let us say, on the economics, assuming this should go forward, and that this obstruction to the run of the salmon were adversely affected as to its influence on the overall fish economy of the Fraser bottom?

Mr. WHITMORE: Yes, this has been looked at by economists and others to try to put an evaluation on individual runs. If the run is of quite a clear cut character, where the catch can be assessed at sea, and in the river, and where there is definite worth in the economy of British Columbia, it may be closely evaluated, and you will likely get a fair figure.

If however the run is associated with other runs coming in, certain devices for purposes of calculation must be used, and there could be a variance of opinion as to just how accurate these estimates are, as to just exactly what number of salmon a particular stream produces, and what is its worth to the economy of British Columbia.

In the case of the Fraser generally, you have under the heading 6.2.1.1 of Board's Report, an overall evaluation given. I do not think there may be need to go beyond this statement. But if you are asking particularly about Stuart lake, then broadly speaking, under the rehabilitation of the Fraser that has been going on, more and more fish are reaching the spawning grounds under the general management formula that of every 5 fish in the run the American fishery takes two fish, the Canadian fisheries get two, and the spawning ground gets one. So if we are able to assess the escapement to the spawning streams on the Stuart lake system as, let us say, 100,000 fish the catch out of the returning run could be calculated at 400,000 as having been taken by industry in the season; that is out of a run of 500,000 fish, 100,000 would go to the spawning ground, American industry would get 200,000 and the Canadian industry would get 200,000 under the terms of the treaty.

Mr. PAYNE: In other words, there would be an escapement of approximately 100,000 into this one area for spawning?

Mr. WHITMORE: That is right.

Mr. PAYNE: Is that in the cycle, or does it happen anyway?

Mr. WHITMORE: No, different areas have different cycles; and the Stuart lake fishery has a dominant year cycle. The figure of 100,000 fish was just pulled out of the hat, so to speak. The Stuart lake run has a history of being the earliest important race to the Fraser system. And I think under the current rehabilitation, the spawning population in the dominant year of the four year cycle would be something in the order of 250,000 fish.

Mr. PAYNE: You assumed the average over the four years would be about what?

Mr. WHITMORE: The average escapement would have regard to the actual run in the 4 year cycle. This run suffered badly from the Hells Gate slide, and early figures would involve the use of pretty rough figures based on the Hudson Bay factor's records, and things of that type, as to the strength of early runs.

But it is well known to have been a substantial one; perhaps in the dominant years to be of the order of 250,000 while in other years it might be in the order of 50,000.

These are just rough estimates to give you what we mean by dominant year as opposed to sub-dominant years.

Mr. PAYNE: Was this study only undertaken this last year?

Mr. WHITMORE: No. As far as Stewart Lake is concerned, there has been knowledge for a number of years through studies and field observation by the salmon commission on the number of fish going to the spawning grounds.

The particular information being studied now through the board's staff is an assessment of the outgoing migration, and to what extent the fry use the three big lakes in the Stuart lake system.

They may stay in one of these lakes for one year, and there will be an assessment at the mouth of Stuart lake in the vicinity of the dam site to determine, if possible, the number of smolts, small fish of the order of from three to four inches long that pass out, the time they go out in relation to the freeze-up, and other factors which have a bearing on matters related to fisheries. This would include timing, whether they all go out within a matter of two or three days, or whether they stay for a longer period of time. Considerable knowledge is known of the various sections of the Fraser, concerning these things, and much work has been done in Chilko lake; but as far as Stuart lake is concerned this is something which has not been given the same amount of attention, and we are hoping that the special staff employed by the board will expedite these studies in relations to the Stuart dam site.

Mr. PAYNE: Their work started when?

Mr. WHITMORE: Oh, just last year, as soon as there was the approval of the two governments in general to the recommendations of the board, and as soon as funds were made available.

Mr. PAYNE: How long would you anticipate it would take for these studies to give you a firm basis of information?

Mr. WHITMORE: I think it is hoped that a three or four year period, that has been laid down by the government as recommended by the board, will find most of the information we need. That is the basis we are working on. But it will always be possible that there might be some insufficiency somewhere, and more time would be needed.

I think generally speaking it is expected that at the end of four years that this further information will give some indication of whether system A should be proceeded with, and that it can meet these four conditions to to which I have referred.

Mr. PAYNE: Is it possible for you to speak of the possible effect in terms of dollars and cents, for the sake of the layman?

Mr. WHITMORE: No, I am afraid I would hesitate to go that far. But I am sure that there could be assurance of uniformity of answer from any group of individuals.

The CHAIRMAN: If there are no further questions of Mr. Whitmore, I shall now thank him very much for coming here.

I understand that Mr. Whitmore is retiring from the fisheries department shortly but that he will continue as director or as member of the International Salmon Commission. And I want to wish him well, and we hope that he enjoys a little fishing himself now.

Mr. WHITMORE: Thank you very much.

The CHAIRMAN: We shall have to deal next with the items in the estimates that were referred to us. Incidentally, Mr. Whitmore is the last witness we propose to call.

Items 277 to 281 agreed to.

Items 486 and 487 agreed to.

Details of above items follow:

WATER RESOURCES BRANCH

| | |
|---|---|
| Item 277. Administration, Operation and Maintenance including Canada's share of the expenses of the International Executive Council, World Power Conference and authority to make recoverable advances in amounts not exceeding in the aggregate the amount of the share of the Province of Manitoba of the cost of regulating the levels of Lake of the Woods and Lac Seul | $ 1,508,354 |
| Item 278. Construction or Acquisition of Buildings, Works, Land and Equipment | 211,000 |
| Item 279. Studies and surveys of the Columbia River Watershed in Canada | 98,745 |
| Item 280. Saint John River—Federal expenditures in connection with investigations to be carried out by the Saint John River Board ................... | 15,000 |
| Item 281. Fraser River—Federal expenditures in connection with investigations to be carried out by the Fraser River Board ....................... | 250,000 |

NORTHERN AFFAIRS AND NATIONAL RESOURCES

| | |
|---|---|
| Item 486. Advances to the Northern Canada Power Commission for the purpose of capital expenditures in accordance with sub-section (1) of section 15 of the Northern Canada Power Commission Act ........................... | $ 1,825,000 |
| Item 487. Advances in accordance with agreements entered into pursuant to the Atlantic Provinces Power Development Act ......................... | 4,958,500 |

Note: Detailed discussions on above items in Editions 1 to 18.

This concludes the regular work of the committee, but we will be holding a meeting of which you will be advised when we shall approve the final report of the committee.

I now ask the members of the committee that if they have any suggestions to offer in regard to the final report, to let me have them as soon as possible, and I shall arrange for a meeting with the steering committee in the next day or two so that we can get busy and prepare our report and have it presented to the house.

Thank you very much for your attendance.

HOUSE OF COMMONS

Third Session—Twenty-fourth Parliament

1960

# STANDING COMMITTEE

# ON

# MINES, FORESTS AND WATERS

*Chairman:* H. C. McQUILLAN, Esq.

## MINUTES OF PROCEEDINGS AND EVIDENCE

No. 19



THURSDAY, JUNE 23, 1960

## ESTIMATES 1960-61 OF THE WATER RESOURCES BRANCH OF THE DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

Including Second Report to the House

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

23356-9—1

## STANDING COMMITTEE ON MINES, FORESTS AND WATERS

*Chairman:* H. C. McQuillan, Esq.

*Vice-Chairman:* Erik Nielsen, Esq.

and Messrs.

Aiken,
Baskin,
Cadieu,
Coates,
Doucett,
Drouin,
Dumas,
Fleming (*Okanagan-Revelstoke*)
Godin,
Granger,
Gundlock,
Hardie,
Hicks,
Kindt,
Korchinski,
Leduc,
MacRae,
Martel,
Martin (*Timmins*),
McFarlane,
McGregor,
Mitchell,
Muir (*Cape Breton North and Victoria*),
Murphy,
Payne,
Richard (*St. Maurice-Laflèche*),
Roberge,
Robichaud,
Rompré,
Simpson,
Slogan,
Stearns,
Woolliams—35.

M. Slack,
*Clerk of the Committee.*

## REPORT TO THE HOUSE

TUESDAY, June 28, 1960

The Standing Committee on Mines, Forests and Waters has the honour to present the following as its

### SECOND REPORT

1. Pursuant to its Order of Reference of March 9, 1960, your Committee has considered and approved items numbered 277 to 281, inclusive, and items 486 and 487, as listed in the Main Estimates of 1960-61 relating to the Department of Northern Affairs and National Resources.

2. Your Committee held hearings on the Order of Reference of the House concerning the said estimates, during which 16 briefs and papers were received and 15 witnesses were examined in addition to 11 federal government officials.

Your Committee wishes to express its appreciation to all witnesses and government officials who gave evidence and provided assistance in its deliberations.

3. Your Committee heard a full explanation of the activities of the Water Resources Branch and the manner in which it carries out its responsibilities.

4. Water is one of Canada's most important resources. Carefully planned use of this resource is of the utmost importance not only to the present generation but to all those to come.

5. The Committe recognizes that the ownership of water resources in areas other than the Northwest Territories and the Yukon Territory and on or under federal lands is vested in the Crown in the right of the Provinces. It recognizes some of the legislative authority vested in the federal government deals with matters which are directly or indirectly concerned with water. The federal government has the authority to legislate on such matters as those pertaining to navigation, sea coast and inland fisheries, international affairs, and interprovincial matters. It also has a concurrent authority along with the provinces on matters relating to agriculture.

6. The Committee notes that the development of our nation is, to a marked extent, dependent on the orderly development of our water resources and that as our population and industry increase there is an increased need for careful planning of the use of water supplies.

7. With the increased growth of the nation there is increased need for the type of investigations which are basic to the orderly development of water resources.

8. Your Committee, therefore, recommends that: the Minister of Northern Affairs and National Resources take the initiative in offering to the several provinces of Canada to undertake studies, in co-operation with the provinces, of multi-purpose river basin developments. This will require an expanded programme of engineering and economic investigations designed to show the possibilities for the development of the water resources of this nation.

*Hydrometric Data: Sedimentation Surveys and Ground Water Surveys*

9. The Committee recognizes that proper use of our water resources is dependent upon the fullest possible information under the above headings.



23356-9—1½

Several witnesses pointed out that the lack of such basic information has been a handicap in the planning of certain specific projects. Your Committee recommends that an expanded programme for obtaining such essential basic information be implemented as early as possible. The need for a great deal more meteorological information appears to be particularly pressing. Specific recommendations on these items will be found later in this report.

*Pollution Abatement*

10. Your Committee recommends that the federal government accelerate investigations of pollution problems in Canada particularly in those areas where it has legislative responsibility. In addition, at the request of the provinces it should provide information which would be useful in establishing objectives of water quality control. The Committee recognizes that much progress has been made in this direction in the past. The province of Ontario is to be commended for the headway it is making in pollution control. However, as our population increases greater effort will be required in the future. As the first step the federal agencies should conduct comprehensive surveys of the types of regulations which are being enforced in the various provinces. The results of such a survey could then be made available to the various provinces and could be used as the basis for establishing the objectives referred to above.

11. The Committee recommends that the Department of National Health and Welfare be asked to conduct studies on a continuing basis to indicate the extent of pollution in the various river systems in Canada and the need for corrective action in specific areas. The Committee suggests that further action is warranted by this department. It suggests specifically that results of the studies conducted by officials of the department be published more frequently so that they may be available to municipal and provincial authorities responsible for regulatory work in different parts of Canada. These publications would also serve to make the general public aware of the nature of the pollution problem.

12. Evidence presented to the Committee indicates that the more progressive industries are undertaking measures to combat and control pollution. It is urged that this activity become general and widespread. However, such measures are undertaken only where the responsible level of government has enacted the necessary legislation and enforces it.

13. Research can do much in the development of new and better measures to combat industrial and municipal pollution. New products alter the character of wastes. Satisfactory and economic methods for the treatment of many pollutants are not known. Provinces, municipalities, industries and federal agencies acting on a co-operative basis should provide direction, encouragement, and financial assistance essential to effective research. It is noted that facilities for the development of better waste treatment and pollution abatement measures are presently very limited in Canada. Your Committee recommends that the federal government take the lead in enlarging these facilities.

14. Dissemination of all the information collected by the various groups concerned with pollution abatement should be arranged so that the benefits of new techniques or projects may be as widespread as possible.

*Navigation*

15. The Committee notes that the federal government has certain direct responsibility toward navigation. While the Committee has not studied this matter in all its aspects it notes that there is a lack of understanding of the extent and nature of the federal responsibility in this field. The Navigable Waters Protection Act was quite effective for conditions which existed at the time it was passed. However, conditions have changed and in the interim

there has not been a clear concept that the protection of waters for navigation should be an integral part of multi-purpose development. There are deep constitutional implications arising out of the ownership of water (vested in the right of the province) and some uses of water (legislative authority over which is vested in the federal government). There is a clear need for the navigation uses of water to be handled in one department. There is a further need to define how the federal responsibility regarding some uses of water should be integrated in relation to the provincial responsibility. This is a task which should be pushed with great vigour by the Minister of Northern Affairs and National Resources.

16. In the administration of the Navigable Waters Protection Act the federal agencies have been somewhat passive rather than positive. That is, they have presumed that unless a proposed structure impaired existing navigation there were no grounds for refusing a licence.

17. The Committee recommends that no major structure should be built on a navigable stream without first establishing whether it would be in the future national interests to construct navigation facilities in conjunction therewith.

*Hydro-Electric Power*

18. The availability of hydro-electric power has been and will be a vital factor in the economic growth of our nation.

The Committee notes that, in those areas where there is the heaviest demand for power, in general, the immediately adjacent power projects have been developed. This is particularly so in the Province of Ontario.

The Committee also notes that there is a huge hydro power development potential in areas remote from major power markets. Such hydro power potentials exist across Canada from the Atlantic to the Pacific and include potential developments on the Yukon River and its tributaries, the Peace River, the Nelson River, the Churchill River, a number of rivers flowing into James Bay and the Hamilton River in Labrador.

There are ample hydro power resources to satisfy the nation's power requirements for many years to come providing the problem of long distance power transmission can be successfully solved.

19. The Committee was advised that opportunity exists for economics through an orderly development of remote hydro sites as well as through the integration of the hydro and thermal plants in different parts of Canada.

Your Committee, therefore, recommends:

(1) that immediate steps be taken to provide a vigorous research programme to study the problem of long distance power transmission;

(2) that immediate and serious consideration be given to the feasibility of establishing a national power grid system in order to make the most efficient use of our hydro and thermal power resources. The success or failure of these investigations will determine whether or not we can make the best use of our great hydro power resources which are a renewable asset.

*Basic Hydrometric Surveys*

20. The Committee recommends that all hydrometric surveys be conducted by one federal agency in co-operation with the provinces. In view of the fact that Water Resources Branch has, for a long period of time, conducted hydrometric surveys in co-operation with the provinces, it is recommended that

duplication be minimized by transferring to the Department of Northern Affairs and National Resources the limited work now being done in this field by the Department of Mines and Technical Surveys, e.g., the hydrometric surveys on the Great Lakes, and by any other federal agencies.

*Meteorological Data*

21. Evidence submitted to the Committee indicated that adequate meteorological data is essential to a complete understanding of the long range characteristics of any drainage basin. Economic development of water power resources and effective flood control measures, in particular, can be adversely affected or seriously prejudiced by the lack of meteorological records of both low and high elevation weather patterns over prolonged periods. The Committee, therefore, recommends that plans for expansion of essential meteorological services be given a high priority of consideration.

*Sedimentation*

22. The Committee notes that sedimentation surveys will be undertaken as soon as funds and personnel are available. This work is essential to the sound long range planning of multi-purpose development of the river basins in Canada.

*Ground Water Surveys*

23. The Committee notes that the Department of Mines and Technical Surveys is conducting basic ground water surveys as rapidly as funds and trained personnel become available. This work should be encouraged.

*Fraser River Board*

24. Your Committee heard evidence from the two federal members of the Fraser River Board concerning what is referred to in the Board's preliminary report dated June, 1958, as System A. Since this proposed System A appears to offer the best possible chance of fulfilling the following objectives:

(1) To provide flood control;

(2) to be an integral part of a major power system;

(3) to be compatible with fisheries; and

(4) to be economically self-supporting through power production,

your Committee recommends that the further studies to establish the physical feasibility of projects in System A and the required additional biological studies relating to fisheries interests be actively pursued. This is in order that a final conclusion as to the merits of System A may be reached at the earliest possible date.

*Hurricanaw River*

25. The Committee heard with interest from witnesses of the proposed Hurricanaw River development project, but it feels that there has been insufficient basic engineering evidence presented to come to any conclusion on this matter.

*Prairie Farm Rehabilitation Act and Canada Water Conservation Assistance Act*

26. The Committee notes that the Prairie Farm Rehabilitation Administration is doing effective work in the prairie provinces. However, the programme established in the early 1930's to meet the conditions of drought and depression was designed to rehabilitate destitute farmers and reclaim lands which has been destroyed by wind erosion. Economic conditions have changed and much of the reclamation work has been completed. Consequently, the P.F.R.A.

programme has been modified to put greater emphasis on the multi-purpose aspect of land and water development. At the present time structures are being built to provide for domestic and municipal water supply to provide for recreation facilities. The modification in the programme suggests the need to re-examine the existing boundaries within and purposes for which the Prairie Farm Rehabilitation Administration should henceforth conduct its work.

27. The Committee notes that the Canada Water Conservation Assistance Act was passed to enable the federal government to participate in conservation and flood control measures of a major character in areas which were not covered by the P.F.R.A. programme.

28. In view of the modification in the requirements of the P.F.R.A. programme, it is recommended that the Ministers of Agriculture and of Northern Affairs and National Resources formulate proposals for a comprehensive national land and water development programme.

29. The broad objective of these proposals should be to recommend a programme which will result in the orderly development of our land and water resources on a multi-purpose basis. The nature of the federal participation should be such as to encourage economically feasible developments while preserving the maximum possible local participation and responsibility. More specifically, the proposals should be asked to address themselves to:

(*a*) the nature and extent of federal financial participation in the multi-purpose development of land and water resources;

(*b*) the type of organizational arrangements which would be most effective to carry out this work;

(*c*) the cost-sharing arrangements which might apply between the municipalities, provincial governments and the federal government;

(*d*) the repayment procedures which should apply to specific purposes; and

(*e*) the economic criteria which would apply to the assessment of alternative possibilities of development.

30. The evidence revealed considerable overlapping of authority relating to water resources, not only as among federal departments, but at various levels of government, federal, provincial and municipal. Your Committee believes that more effective development of water resources can only be accomplished by better co-ordination of the work now being done at all levels of government.

31. A copy of the Minutes of Proceedings and Evidence in respect of the said estimates is appended.

Respectfully submitted.

H. C. McQUILLAN,
*Chairman.*

# MINUTES OF PROCEEDINGS

THURSDAY, June 23, 1960.
(21)

The Standing Committee on Mines, Forests and Waters met *in camera* at 2.20 p.m. this day, the Chairman, Mr. H. C. McQuillan, presiding.

*Members present:* Messrs. Aiken, Coates, Doucett, Fleming, (*Okanagan-Revelstoke*), Hicks, Korchinsky, McFarlane, McQuillan, Muir (*Cape Breton North and Victoria*), and Payne. (10)

The Committee considered a draft report which had been considered by the Steering Committee and recommended for the approval of the Main Committee. Following certain minor amendments thereto, the Committee approved the draft report as amended and ordered that the Chairman present it to the House.

Mr. Payne, seconded by Mr. Hicks, expressed the appreciation of the Committee to the Chairman for his guidance throughout its meetings, and to the Clerks of the Committee and the Committee Reporters for their efficient service to the Committee.

At 2.45 p.m. the Committee adjourned to the call of the Chair.

Eric H. Jones,
*Acting Clerk of the Committee.*